# TF 2000

# BGA/CSP Rework System

**MANUAL NO. 5050-0482**
**REV. C**

## TABLE OF CONTENTS


Safety ..... 4

Introduction ..... 5

Packing Contents ..... 5

Features ..... 7

Set-Up ..... 10

Operation ..... 13

- Before Operating ..... 13
- General Operating Procedure ..... 13

Explanation of Each Operation ..... 17

- Placing PCB into Board Holder ..... 17
- Component Alignment and Placement ..... 17
- Component Reflow ..... 19
- Adjusting Airflow ..... 20
- Component Removal ..... 20

Selecting a Profile ..... 21

Creating and Saving Profiles ..... 21

PC Software ..... 24

- Setup Tab ..... 25
- Optics Tab Alignment View ..... 27
- Print/Review ..... 29
- Operation Tab ..... 30
  - Process Control/Validation ..... 31
- Profile Development Tab ..... 33
  - General Information ..... 34
  - Profile Creation ..... 36

Maintenance ..... 39

- Cleaning the Blower Filter ..... 39
- Replacing the Top Heater ..... 39

Alignment and Calibration ..... 41

PCB to Optics ..... 41
Sliding Shaft Holder (Indexing) ..... 42
Vacuum Nozzle Planarity ..... 33
Reflow Head Planarity ..... 44
Reflow Head – “Y” Directional Adjustment ..... 46

General Troubleshooting ..... 47

Initial Operation Flow Chart ..... 48
Nozzle Operation Flow Chart ..... 49
Vacuum Pick Operation Flow Chart ..... 49
General Troubleshooting Table ..... 51

TF 2000 L/LE Model Differences ..... 52

Installing the Board Holder ..... 52
Bottom-Side Heaters ..... 53
Sliding Shaft Holder Indexing ..... 54
Alignment and Calibration Differences ..... 55

Specifications ..... 56
Instructions for using the Board Supports ..... 58

Accessory Items ..... 59

## Safety

The following are safety precautions that personnel must understand and follow when using or servicing PACE products.

1. **POTENTIAL SHOCK HAZARD -** Repair procedures on PACE products should be performed by Qualified Service Personnel only. Line voltage parts may be exposed when the equipment is disassembled. Service personnel must avoid contact with these parts when troubleshooting the product.
2. To prevent personnel injury, adhere to safety guidelines in accordance with OSHA and other applicable safety standards.
3. Always use PACE systems in a well ventilated area. A fume extraction system, such as those available from PACE, is highly recommended to help protect personnel from solder flux fumes.
4. Exercise proper precautions when using chemicals (e.g., solder paste). Refer to the Material Safety Data Sheet (MSDS) supplied with each chemical and adhere to all safety precautions recommended by the manufacturer.
5. The following safety precautions cover use of PACE hot air systems/hand pieces (e.g., ThermoFlo®, ThermoJet®).
    a) Be careful when using in places where there are combustible materials.
    b) Do not use in the presence of an explosive atmosphere.
    c) A fire may arise if a hot air hand piece is not used with care. Do not leave the hand piece unattended when in use.
    d) The heater assembly housing and any installed nozzle are hot when the system is being cycled and for a period of time thereafter. DO NOT touch either the heater assembly housing, nozzle or direct heated air stream. Severe burns may result!

## Introduction:

Thank you for purchasing the TF 2000 BGA/CSP Rework Station. As electronic devices continue to get smaller, lighter and more compact, components and printed circuit boards are also becoming smaller and the amount of available space on PCBs is continually decreasing. In order to maximize board space, area array devices are growing in popularity. Area array devices are BGAs, CSPs and "micro-BGAs", and Flip Chips. These devices require an optical overlay vision system to ensure proper placement and high levels of process control during rework to ensure successful installation. The TF 2000 has been specifically designed to rework these types of components and can also install and remove a variety of other SMT devices.

**NOTE:** This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference and (2) This device must accept any interference received, including interference that may cause undesired operation.

The TF 2000 also complies with 98/37/EC and 89/336/EEC.

**Caution: During normal operation, the top heater, nozzle, bottom-side-heater(s) and halogen lamps will get hot. Do not contact them directly as serious injury could occur.**

## Packing Contents

***TF 2000 with Video Monitor***

1. TF 2000B, BE, BL, or BLE: 1 each
2. TF 2000R: 1 each
3. TF 2000P: 1 each
4. Video Monitor: 1 each
5. B/C Video Cable: 1 each
6. Hand Held Vacuum Pick for removal: 1 each
7. Suction rubber (spare for #9): 3 each
8. Vacuum nozzle for positioning: 1 each Large, Medium and Small sizes
9. Hex Wrench Set and Screwdriver: 1 each
10. Top Heater Element (spare): 1 each
11. Halogen Lamp (spare): 2 each
12. TF 2000 Manual: 1 each
13. K-Type ThermoCouple: 2 each

***TF 2000 with PC***

1. TF 2000B, BE, BL, or BLE:  1 each
2. TF 2000R:  1 each
3. TF 2000P:  1 each
4. Computer:  1 each
5. Computer Monitor:  1 each
6. S-Video Cable:  1 each
7. TF 2000 Software Package:  Installed on PC
8. Serial Cable:  2 each
9. Hand Held Vacuum Pick for removal:  1 each
10. Suction rubber (spare for #9):  3 each
11. Vacuum nozzle for positioning:  1 each Large, Medium and Small sizes
12. Hex Wrench Set and Screwdriver:  1 each
13. Top Heater Element (spare):  1 each
14. Halogen Lamp (spare):  2 each
15. TF 2000 Manual:  1 each
16. K-Type ThermoCouple:  2 each

## Features

1. The TF 2000 System is comprised of three self-contained stations:
   The Reflow Station (Model TF 2000R)
   The Placement Station (Model TF 2000P), and
   The Base/Pre-Heater Station (Models TF 2000B, TF 2000BE, TF 2000BL, or TF 2000BLE)
   Each individual station is lightweight and compact, allowing for easy set-up and portability.
2. Up to 40 reflow profiles can be stored by the TF 2000. Saved profiles can be recalled at the touch of a button and are displayed on the LCD display panel.
3. A colored LED indicates each phase of the reflow cycle so the status of each operation can be easily seen and monitored.
4. The Placement Station can easily handle components up to 70 mm square. If needed, a split screen function is available through the optional software package.
5. A highly efficient, 1000-watt topside heater used in conjunction with a truly unique nozzle design insures the uniformity of the temperature across the assembly.
6. The ceramic panel bottom side heater with a wide heating area is incorporated to insure the co-planarity of the PCB, to prevent warping, and to enhance the reflow of large BGAs.
7. The blower and vacuum pumps are self-contained. No external air supplies are required.
8. A cooling fan automatically activates at the end of the reflow cycle to cool the component, PCB, and nozzle.
9. The TF 2000 is versatile, adaptable and ensures repeatable results.

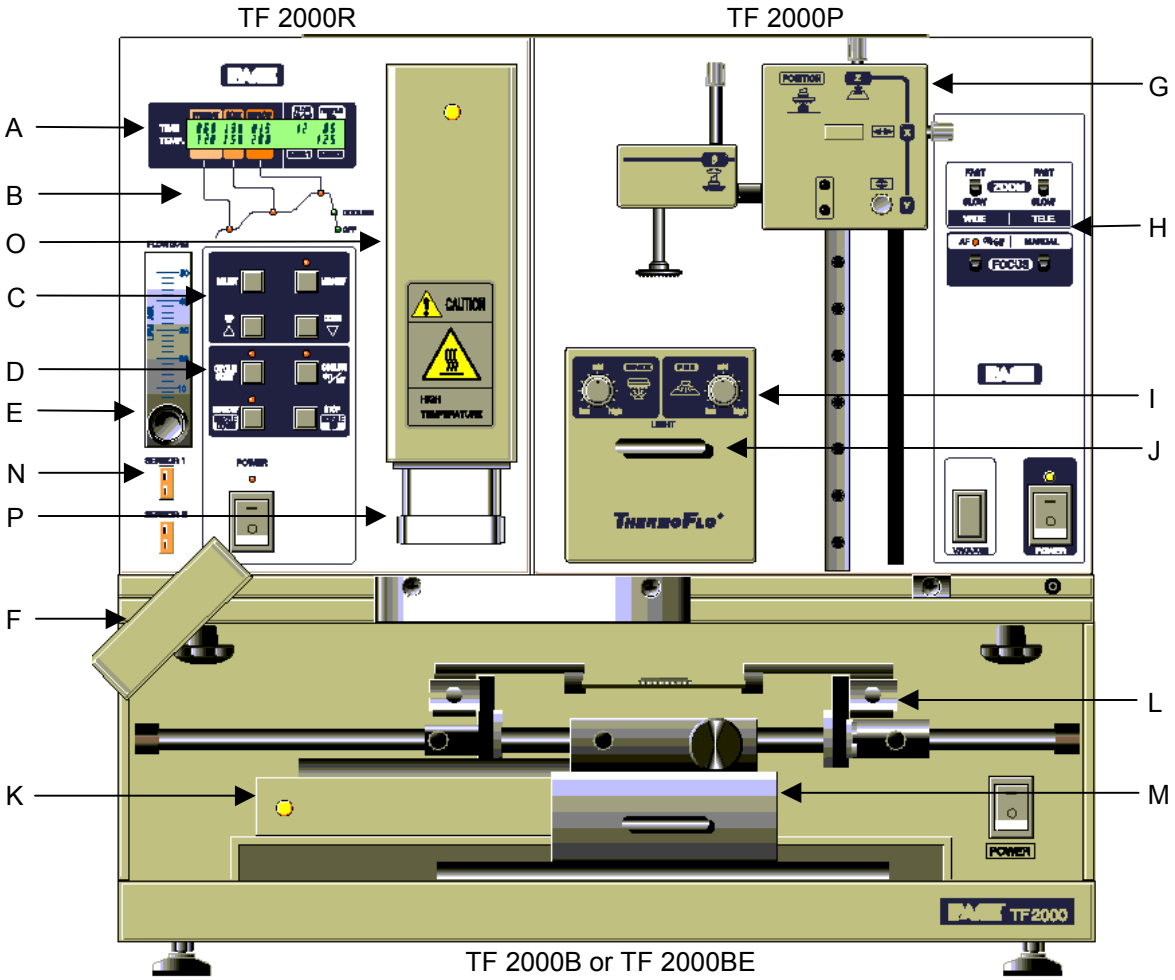



**Figure 1: TF 2000 BGA/CSP Rework Station**

***Features:***

Please refer to Figure 1.

| | |
|---|---|
| A) LCD Display Panel | Displays profile variables (time and temperature) and allows the user to enter/modify profile parameters. |
| B) Phase Display Panel | Each phase of the reflow cycle is indicated by this panel. |
| C) Data Entry Panel | Used to enter/modify reflow profile parameters and to save or recall profiles. |

| | |
|---|---|
| D) Operations Panel | Allows the operator to start/stop a profile cycle, turn on/off the cooling fan and raise/lower the reflow head. |
| E) Air Flow Meter | This device is used to control and monitor the airflow. |
| F) Cooling Fan | The component and the PCB are cooled down by the cooling fan, which activates automatically, after the reflow cycle is completed. |
| G) Alignment Apparatus | X, Y, Z and Θ aspects of the component position are adjusted in relation to the land pattern on the PCB through this apparatus. |
| H) Camera Control | The zoom and focus functions of the optical overlay system are controlled at this location. The Auto-focus feature may also be selected. |
| I) Light Control | The upper (component side) and lower (PCB side) lights within the optics housing can be adjusted for intensity (overlay contrast) at this location. |
| J) Optics Housing | Contains the camera and beam splitter. The housing is retractable and should be kept in the retracted position when not in use. The lights for the optics will turn on/off automatically when the housing is extended. |
| K) Bottom Side Heater | Used to warm the PCB from the underside. It is an IR type of heating source. The pre-heater temperature is set in the “PRE-HEAT” display and will remain on throughout the reflow cycle. When the cycle enters the reflow phase, the bottom-side heater temperature will increase by 30ºC to ensure successful reflow. A power consumption indicator light is mounted onto the pre-heater to indicate when it is drawing power.<br>****NOTE:** For TF 2000L/LE models, refer to Section 10 for model differences. |
| L) Board Holder | The board holder is fully adjustable in both the X and Y directions. The right side of the holder is spring loaded to hold the PCB securely. Fine adjustment in the X direction is achieved by using the adjustment knob on the Sliding Shaft Holder. |

| | |
|---|---|
| M) Sliding Shaft Holder | Supports the rail system for the board holder. It is also used to index the table from the Placement Position to the Reflow Position using the handle on the front. |
| N) Sensor 1 & 2 Inputs | The sensor inputs have been designed to use K-type thermo-couples. Measured temperatures are displayed on the LCD display, real time, and can be interfaced to a PC using the TF 2000 Software (optional) through the serial port on the back of the TF 2000R. |
| O) Reflow Head | Contains the top-side heater and moves up and down via an electric motor that is controlled through the operations panel. A power consumption indicator light is mounted onto the front of the reflow head to indicate when it is drawing power. The reflow head is clutched to prevent excessive downward force from being applied. |
| P) Nozzle | The nozzles for the TF 2000 are easily changed. Several varieties are available. Use caution and proper hand protection when changing nozzles, as they will be hot. |

****NOTE:** For TF2000 L/LE models, refer to Section 10 for a detailed description of model differences.

# 1 SET-UP

## *TF 2000 Setup & Connection to Video Monitor*

1-1 Place the TF 2000B, TF 2000BE, TF 2000BL, or TF 2000BLE on a flat and stable bench. Refer to Section 10 for board holder installation on L/LE models.

1-2 Place the TF 2000R and TF 2000P on the base as indicated in Figure 1.

1-3 Secure the TF 2000R and TF 2000P by following the directions in the box containing the base unit. Refer to Figure 1.

1-4 Connect the power cables as indicated in the wiring diagram label on the back of the units. See Figure 2.

1-5 Connect the hand-held vacuum pick to the vacuum port on the front of the TF 2000P and hang the vacuum pick on the side of the TF 2000P using the bracket provided.

1-6 Connect a B/C cable (included) and a power cable between the video monitor and the TF 2000P

1-7 Connect the main power cable to an appropriate 115 VAC, 60 Hz or 230 VAC 50 Hz power supply.

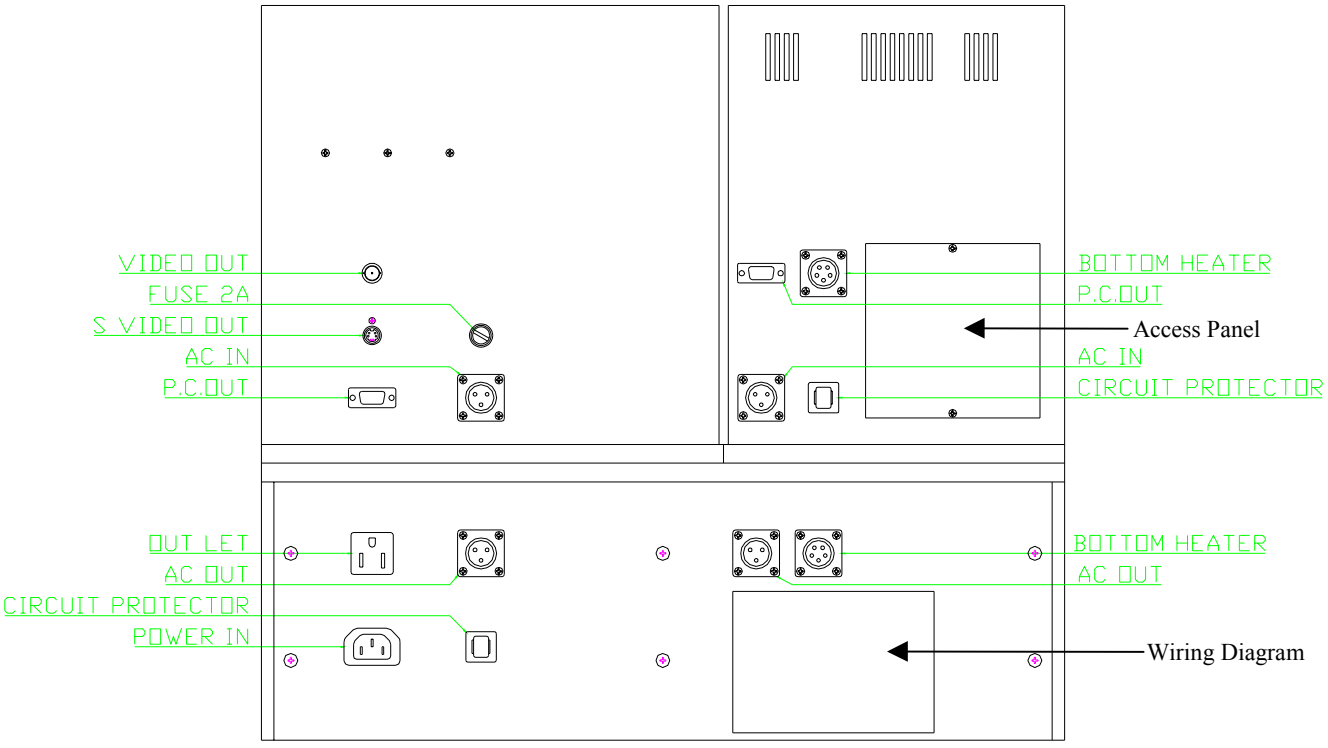



**Figure 2: Back of TF 2000**

***TF 2000 Set up & Connecting to PC (Optional Package)***

1-1 Place the TF 2000B, TF 2000BE, TF 2000BL, or TF 2000BLE on a flat and stable bench.
1-2 Place the TF 2000R and TF 2000P on the base as indicated in Figure 1.
1-3 Secure the TF 2000R and TF 2000P by following the directions in the box containing the base unit. Refer to Figure 1.
1-4 Connect the power cables as indicated in the wiring diagram label on the back of the units. See Figure 2.
1-5 Connect the hand-held vacuum pick to the vacuum port on the front of the TF 2000P and hang the vacuum pick on the side of the TF 2000P using the bracket provided.
1-6 Connect the S-video cable (included) to the S-video port on the back of the TF 2000P. Then connect the other end of the cable to the S-video port on the back of the video expansion card on the PC. (See Figure 3)
1-7 Connect the serial port on the back of the TF 2000R to Serial Port 1 (located next to the monitor port) on the computer using one 9 pin serial cable (included). (See Figure 3)
1-8 Connect the serial port on the back of the TF 2000P to Serial Port 2 on the computer using the other 9 pin serial cable (included). (See Figure 3)
1-9 Connect the power cable to an appropriate 115 VAC, 60 Hz or 230 VAC 50 Hz power supply.
1-10 Do not plug the PC or PC monitor into 1 amp power receptacle on the back of the TF 2000P.

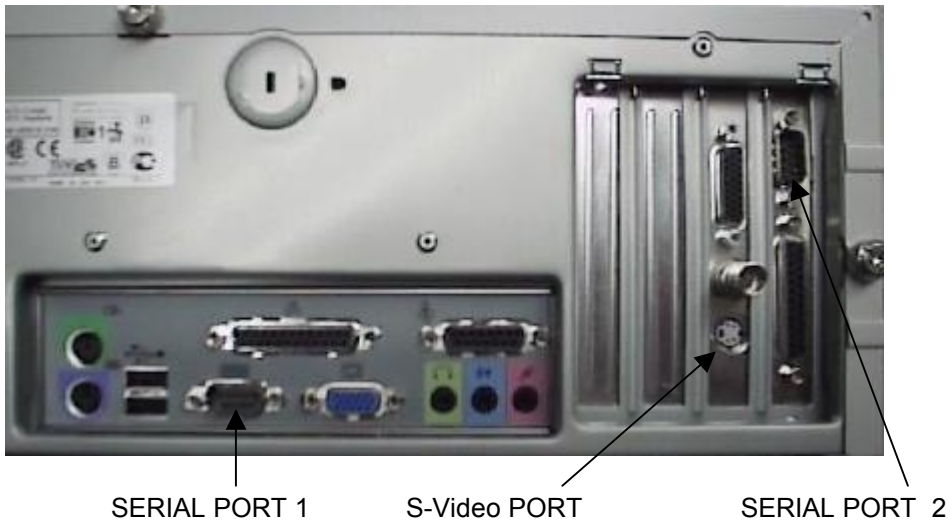



**Figure 3: PC Back Panel**

# 2 OPERATION

## 2-1 Before Operating

- Make sure the TF 2000 is on a stable platform
- It is recommended that the TF 2000 be turned on for at least 15 minutes before use to ensure the Bottom Side heater has reached its set temperature and stabilized. Once the bottom-side heater is at temperature it will deliver consistent heating, ensuring highly repeatable heating from operation to operation.
- It is advisable to conduct a trial operation each day to ensure all systems are operating properly. Also, it is important to verify the airflow of the unit: Maximum airflow is 25 l/min and Minimum airflow is 18 l/min.
- Verify that the devices/parts being soldered to the PCB do not exceed the height limitations. Exceeding the limitations may interfere with the operation of the machine.

    1. The maximum height of any component or device on the top of the PCB is limited to 30 mm (1.2”).
    2. The maximum height of any component or device on the bottom of the PCB is limited to 15 mm (0.6”).

## 2-2 General Operating Procedure

1. Insert PCB into Board Holder. See Figure 4.

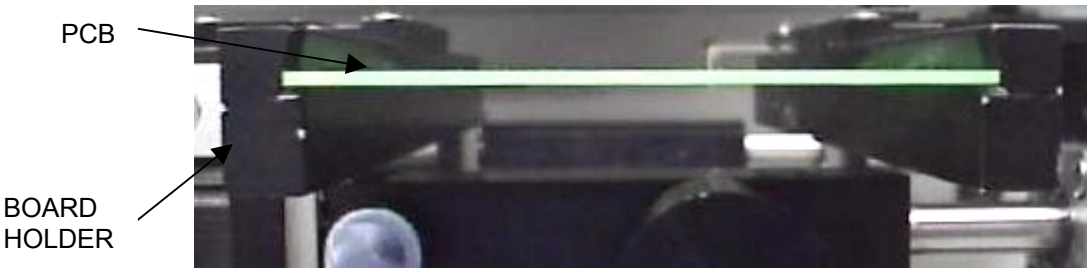



**Figure 4: Board Holder and PCB**

2. Apply flux or solder paste: One of the following methods is applicable depending on the rework conditions, the specification of Device/PCB, or operator preference.
    A) Dispense flux on the land pattern using a brush or flux pencil.
    B) Apply solder paste to the land pattern using a conventional stenciling technique
    C) Apply paste or flux to the BGA, solder ball side, by means of a flux application tool. See Reference Section.

D) Print paste on the BGA, solder ball side, by using a component stenciling tool kit. See Reference Section.

**Note:** Method 2 must be completed prior to insertion of PCB into board holder and methods 3 and 4 apply flux/paste to the underside of the component, not the PCB. They should be performed before placing component with vacuum pick on TF 2000P.

3. Activate vacuum on TF 2000P and pick up component using vacuum nozzle on placement station.

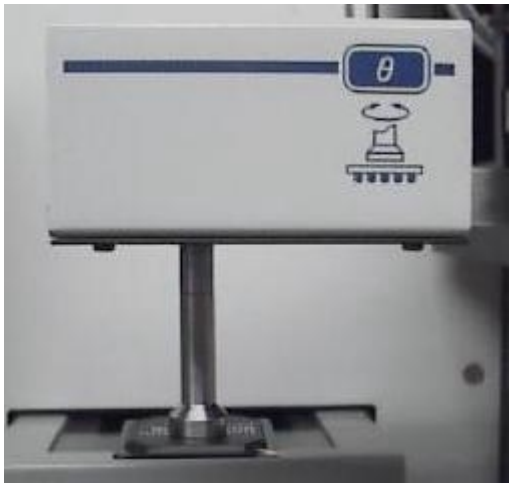


**Figure 5: Component held by Vacuum Pick on TF 2000P**

4. Pull the optics housing out from the front of the TF 2000P using the handle. Be sure the Sliding Shaft Holder is in the placement position.

5. Align component solder ball/lead pattern to the land pattern on the PCB using the adjustment knobs on the alignment apparatus. See Figure 6. The BGA ball side and the PCB pattern side are super-imposed on the video or computer monitor, depending on chosen configuration, by the optical system.

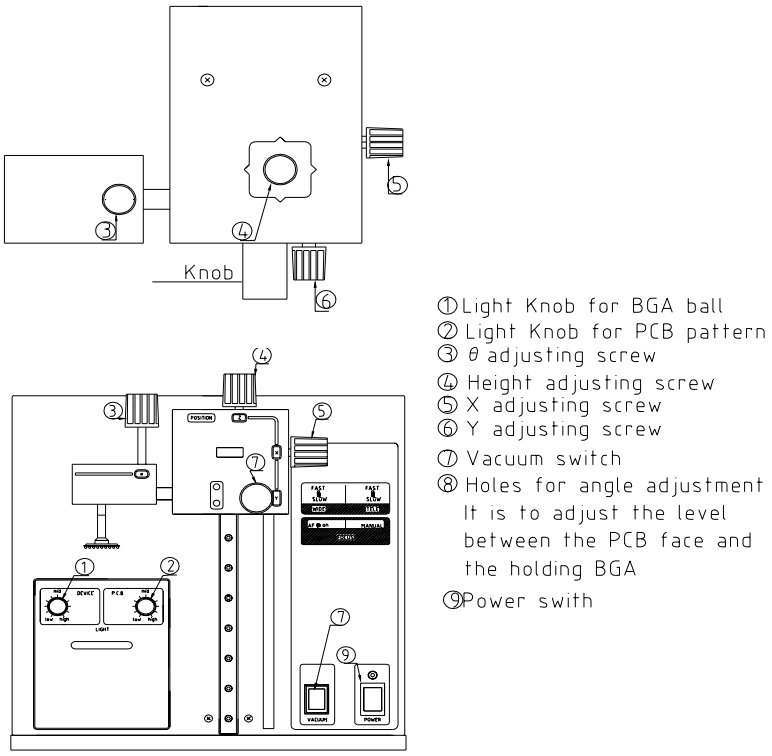
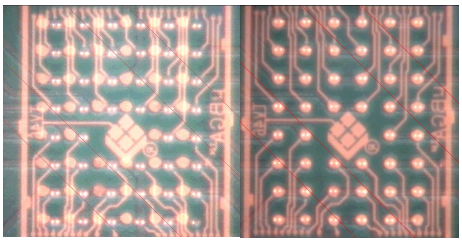



**Figure 6: TF 2000P**

A) Zoom in so the lands on the PCB fill the screen and center the land pattern on the display.
B) Adjust the lighting so both images are clear.
C) Align the component to the land pattern using the X,Y and Θ. See Figures 6 and 7.



(A) (B)

**Figure 7 - Unaligned (A) and Aligned component (B) as they would appear.**

6. Lower the Alignment Apparatus to PCB.

7. Release component by turning off the vacuum and return alignment apparatus to the upper position. See Figure 6.

8. Using the handle on the Sliding Shaft Holder, index the table from the Placement Position to the Reflow Position.

9. Select the desired profile or enter time and temperature parameters for pre-heat, soak, and reflow phases. Those values will be shown on the LCD display. See Figure 8. As each phase in the reflow profile is entered, the LED indicator lights will show which phase the process is in. See Figure 8.

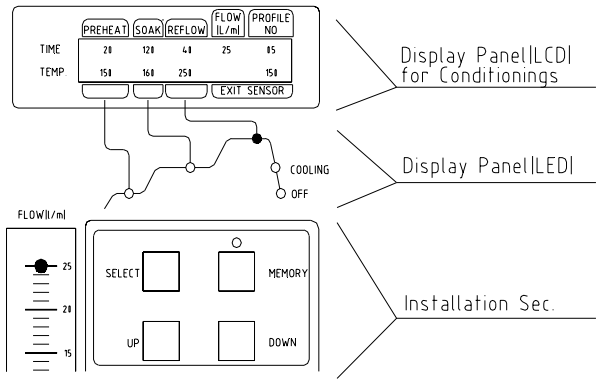


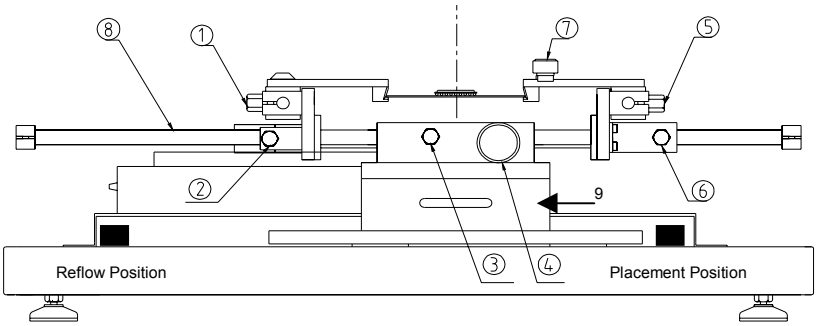

**Figure 8: Display and Data Entry Panel**

10. Once the reflow profile has been completed, the reflow head will lift up automatically and the cooling fan will turn on for 55 seconds. Airflow from the cooling may be directed by loosening the locking thumb screw on the fan and rotating it around its shaft.

# 3 EXPLANATION OF EACH OPERATION

## 3-1 Placing BCB into Board Holder - Please see Figure 9.

1. Center the sliding shaft (8) in the holder (9).
2. Adjust the sides of the board holder so that the distance between them is 3 mm smaller (half the width of the rail) than the width of the PCB. Secure the sides by tightening the setscrews (6 & 2)
3. The right side of the board holder is spring loaded. Insert the PCB into the support slots while holding the right side of the board holder open. When the PCB is positioned, let the right side close.




①Screw ②Screw ③Screw ④Knob for Slide shaft
⑤Screw ⑥Screw ⑦Screw ⑧Slide shaft 9) Sliding Shaft Holder

**Figure 9: Board Holder and Base**

## 3-2 Component Alignment and Placement - Please refer to Figures 6 and 9.

1. Set the sliding shaft holder at the Placement Position at the far right side of the base
2. Verify that the height (Z-axis) adjusting screw (#4, Fig. 6) is positioned in the center of the square hole as shown in Figure 4. This position is the reference point for all alignment procedures.
3. Extend the optical housing by pulling the handle towards you. The lights will come on automatically.
4. Focus the array pattern on the PCB by focusing manually or by using the AUTO FOCUS feature. When using the AUTO FOCUS feature, switch the feature **off** after the array pattern has been focused.
5. Center the PCB array pattern on the Display. Zooming in on the array allows for easier centering.

6. Tighten the setscrews (#1 & 5, Fig. 9) to secure the “Y” position of the PCB.
7. Tighten the setscrew (#3, Fig. 9) on the sliding shaft holder (#9, Fig. 9) to secure ”X” position of the PCB.
8. Switch on the vacuum switch (#7, Fig. 6).
9. Hold the component to be placed using the vacuum nozzle. See Figure 7.
10. Adjust the lighting using the adjustment knobs (#1 & 2 Fig 5) so the image of the PCB land pattern and the image of the solder balls on the component can be seen clearly.
11. Adjust the height of the device with the height (Z-axis) adjusting screw (#4 Fig 5) to bring solder balls/leads into focus. Failure to focus the component may result in inaccurate alignment.
12. Turn the “AUTO-FOCUS” feature on after the PCB and component are focused.
13. Adjust θ aspect of the component by turning the θ adjustment knob (#3, Fig. 6).
14. Adjust the X and Y aspects of the component by adjusting the X and Y adjustment knobs (#5 & 6, Fig. 6).
15. When the component is aligned (See Figure 7), return the optics housing to its retracted position. The lights will turn off automatically.
16. Using the handle, lift the alignment apparatus upwards by hand to release, then lower the apparatus slowly. As the apparatus reaches the PCB, the damper will engage to ensure the component lands softly on the PCB.

    **NOTE:** The alignment apparatus cannot be lowered while the optics housing is extended.

    **DO NOT DROP THE ALIGNMENT APPARATUS FROM THE UPPER POSITION.**

    **NOTE:** When repeating operations using the same PCB and device, steps 4 and 11 may be eliminated. However, when changing devices, it is important to include steps 4 and 11 in the initial setup procedure.

3) Confirm that the component has contacted the PCB. Turn off the vacuum switch (#7, Fig 6).

   When repeating operations using the same PCB and device, the mechanical stop on the right side of the alignment apparatus may be set to ensure repeatability.

4) Return the alignment apparatus to its original position.

19) Move the sliding shaft holder to the Reflow Position using the handle.

**NOTE:** For TF 2000L/LE models, refer to the Sliding Shaft Holder Indexing portion of Section 10 for a description of model differences.

**3-3 Component Reflow** - Please refer to Figure 10

1) Make sure that an appropriately sized nozzle is fitted to the reflow head.
2) Verify the sliding shaft holder is at the Reflow Position at the far left side of the base
3) Select a profile or enter reflow parameters. Refer to section 4.

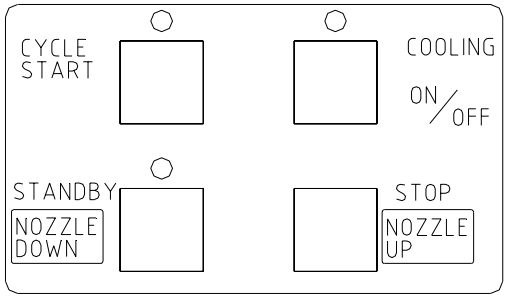



**Figure 10: Operations Panel**

4) Push the NOZZLE DOWN button. The nozzle will go down and stop automatically 16 mm (will vary with PCB thickness) above the PCB. See Figure 10.
5) Confirm that the component position is aligned with the nozzle. Press and hold the NOZZLE DOWN button. The reflow head will lower itself, slowly. Lower the reflow head until there is no gap between the nozzle and the PCB. See Figure 11. If you need to raise the reflow head up by a slight amount, press the NOZZLE UP button briefly.

When repeating operations using the same PCB and device, the mechanical stop on the left side of the reflow apparatus may be set to ensure repeatability.

The reflow head has a clutch that will engage if the nozzle applies pressure on the PCB or the mechanical stop. This ensures the safety of the PCB and the motor that drives the reflow head.

**NOTE:** In some instances the space around a component will be insufficient to bring the nozzle into contact with the PCB. Should this occur, select a nozzle with dimensions that

are similar to the component body. For reflow, position the nozzle 1 mm above the component. The time of the reflow cycle may have to be adjusted to insure satisfactory results. A thermo-couple should be used to verify reflow conditions.

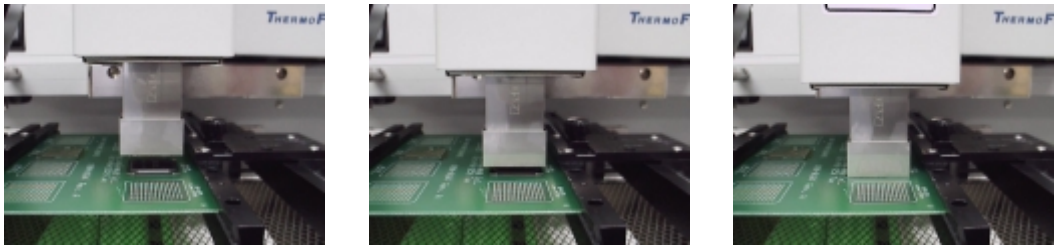


**Figure 11: Properly Positioned Nozzle in Relation to PCB**

6) When the nozzle is properly positioned, press the CYCLE START button. The PREHEAT LED on the Phase Display Panel will light and the reflow cycle will begin.
7) The Phase Display Panel (See Figure 8) will indicate the phase of the reflow cycle (PREHEAT, SOAK, REFLOW and COOLDOWN) and the time for each phase will be counted down on the LCD Display. An audible alarm will sound seven (7) seconds before the end of the reflow phase.
8) When the reflow cycle is complete, the nozzle will automatically raise and the COOLING FAN will turn on, cooling the soldered component, PCB and nozzle.
9) Do not remove the PCB from the board holder until the COOLING LED has gone off and the OFF LED is lighted.

### 3-4 Adjusting Airflow

1) The knob on the air flow meter adjusts the air flow. Make sure to match the air flow meter value with the value of FLOW on the LCD Display. The actual air flow will not be changed by the flow value of the display panel.

### 3-5 Component Removal

1) Component removal is accomplished in the same way as the reflow.
2) When the audible alarm signals 7 seconds before the end of the reflow phase, push the VACUUM button to turn on the vacuum pump.
3) Once the reflow head raises up, remove the component by using the hand held vacuum pick.
4) It is possible to shorten the profile for removals.

## 4 SELECTING A PROFILE

Please refer to Figure 8 for this section.

1. Using the SELECT button, move the cursor to the PROFILE NO. position.
2. Select a profile by pressing the UP or DOWN buttons. The TF 2000 can store up to 40 profiles. Profile memory locations from 00 to 39 are available. The TF 2000 comes with three profiles loaded (locations 00, 01, and 02). These should be used as baselines when creating profiles. User profiles can be stored in locations 03 through 38. Location 39 is used as a working memory when profiles are downloaded from a PC. See Software section. The profile parameters in use are visible on the LCD display.

## 5 CREATING AND SAVING PROFILES

Please refer to Figure 8 for this section.

### 5-1 General Information

The TF 2000 comes with three profiles already installed that should be used as baselines when developing profiles. The profile in memory location 00 is recommended as a starting point for area arrays smaller than 35 mm square. The profile in memory location 01 is recommended for reflowing area arrays 35 mm square and larger. Profile number 02 is essentially the same as profile number 01, but adds a temperature spike (30 °C) from the Bottom Side heater during the reflow phase.

### 5-2 How to install a profile:

1) Using the SELECT button, move the cursor to the item to be changed.
2) Change the value by pressing the UP or DOWN button.
3) After all values have been set, press the MEMORY button once. The LED above the MEMORY button will go on.
4) Press the SELECT button to move the cursor to PROFILE NO.
5) Using either the UP or DOWN button, choose a profile memory location (03 through 38) to save the profile into.
6) When the memory location has been selected, press the MEMORY button until the audible signal is heard indicating the profile has been saved to the memory location selected.
7) Once the profile has been saved, the LED lamp will go out.

**NOTE:** The above procedure can be used to create and save new profiles and to modify existing profiles. Saving a profile to a memory location that is in use will overwrite the existing profile.

## 5-3 Additional Information

1) Temperature settings are as follows:

   - **Preheat Temp** is the temperature of the bottom side heater
   - **Soak Temp** is the set temperature of the top heater during soak, bottom heater remains at "pre-heat" temp.
   - **Reflow Temp** is the temperature of the top heater during reflow. The bottom-side heater can either remain at its set temp or a "Spike" of 30 degrees C may be set. See Software Section.

2) Time and temperature parameters can be changed while a reflow cycle is running. However, the PROFILE number itself can not be changed.
3) To decide a temperature value, it is recommended to use a thermo-couple to take temperature measurements. Profile creation is most successful when thermo-couples are used. For assistance, contact PACE.
4) To ensure a successful installation the following conditions should be met in each profile.

   During the PRE-HEAT phase, the PCB should experience a temperature of between 95 and 105 ºC before entering into SOAK

   During the SOAK phase, the solder balls should experience a temperature between 140 to 160 ºC for 45 to 60 seconds.

   During the REFLOW phase, the solder balls should experience a temperature of 205 to 220 ºC for 10 to 20 seconds.

5) The preset default profiles located in memory locations 00-02 are as follows: (Time/Temperature)

| Profile | Preheat | Soak | Reflow |
|---|---|---|---|
| 00 | 60/180 | 100/110 | 100/230 |
| 01 | 61/210 | 100/140 | 120/280 |
| 02 | 60/210 | 100/140 | 130/280 |

**NOTE:** Above values are expressed as seconds/°C.

6) During the Reflow phase, the Bottom Side heater provides a 30 °C temperature spike to aid in the reflow process. This is an automatic feature and can be disabled by entering “61” seconds in the Preheat time field prior to the start of the reflow cycle. The “SPIKE” allows for more even heating of PCB and Device as well as lower “REFLOW” temperatures.

# 6 PC SOFTWARE

TF2000 application software comes pre-installed on the optional PC configuration of the TF 2000 BGA/CSP Rework System. The software provides numerous features not included with the standard monitor configuration. These features include:

- Allows password to be entered to restrict creation and modification of existing profiles.
- View images from the Vision Overlay System (VOS).
- The ability to save images electronically.
- Real time split screen function allows for quick alignment of large components or components with numerous solder balls.
- Use up to 2 Thermo-Couple Sensor Inputs to monitor reflow profile.
- Time and Temperature parameters are displayed on screen.
- Incorporate work instructions for operators into profiles.
- Ensures process control by restricting operator access to profile parameters.
- Allows for process validation using a thermo-couple.
- Document operations for quality assurance.

The TF 2000 application software consists of 5 operational screens indicated by folder tabs across the top of the display. Click on the associated folder tab to access the operational screen.

## 6-1 Setup Tab

The Setup screen allows for the configuration of the TF 2000 software.

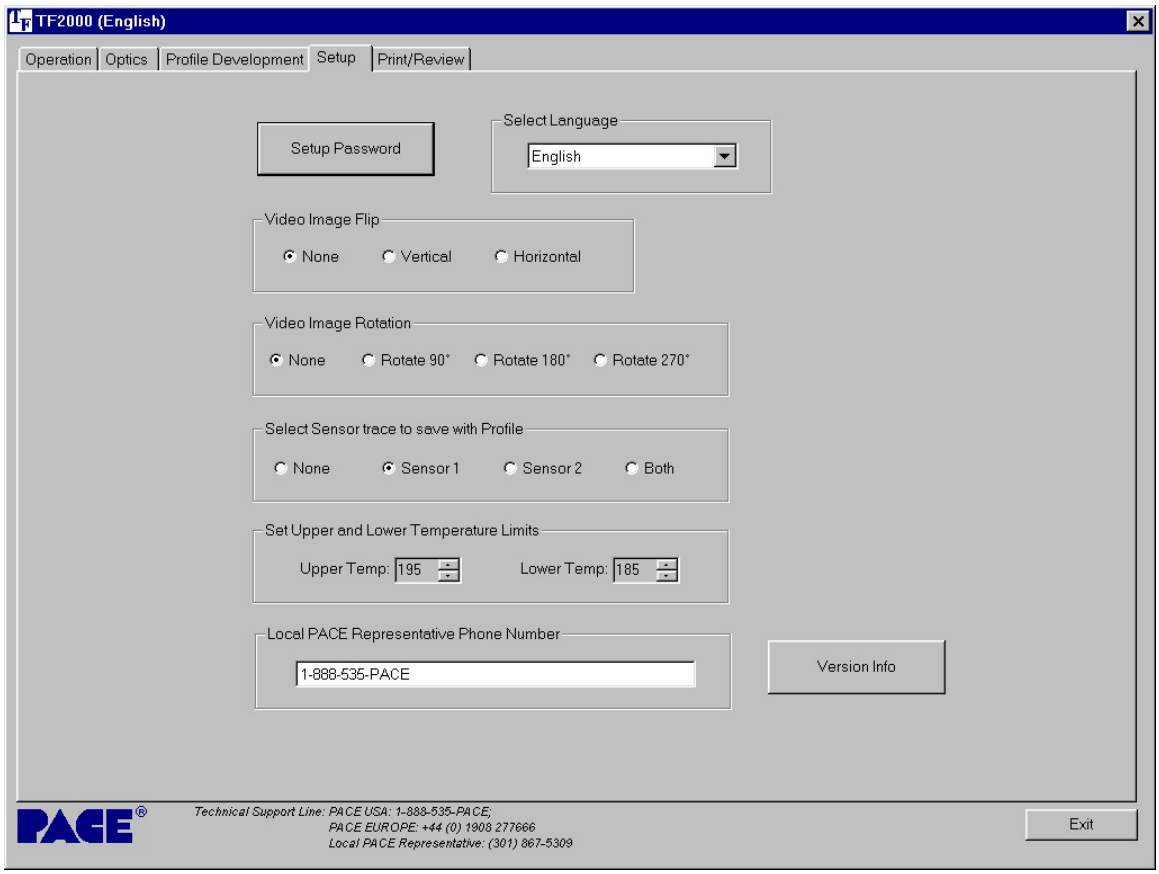



**Figure 12: Setup Tab**

1) Setup Password Button – Restricts access so that profiles can not be modified, deleted, or created by unauthorized users. Clicking this button causes a pop up box to be displayed. (See Figure 13)
2) Select Language – Allows for selection from 6 different languages, including English, German, French, Italian, Spanish and Swedish from a drop down menu.
3) Video Image Flip – Provides a means to vertically or horizontally flip the camera image (on the Optical Alignment screen) by digitally manipulating the displayed image.
4) Video Image Rotation – Rotates the displayed image (on the Optical Alignment screen) by the amount indicated for the selected field.

**NOTE:** Selecting any of the Video Image Flip or Video Image Rotation options may cause the displayed image to

appear “jerky” or “sluggish”, due to the calculation time required to digitally flip or rotate an image.

5) Select Sensor trace to save with Profile – Allows one or both thermocouple (sensor) inputs to be saved with any given profile.
6) Local PACE Representative Phone Number – Allows for entry of PACE Local Representative or PACE customer service telephone number for easy reference.
7) Set Upper and Lower Temperature Limits – Provides a reference zone for reflow, typically set at 195 and 220°C. Horizontal green lines on the graph represent upper and lower limits.

**Figure 13: Password Setup Box**

## 6-2 Optics Tab Alignment View

This screen is used for aligning the component solder balls to the PCB land pattern using the vision overlay system (VOS). Camera Zoom and Focus can be controlled from this screen as well as the Real Time Split Screen feature.

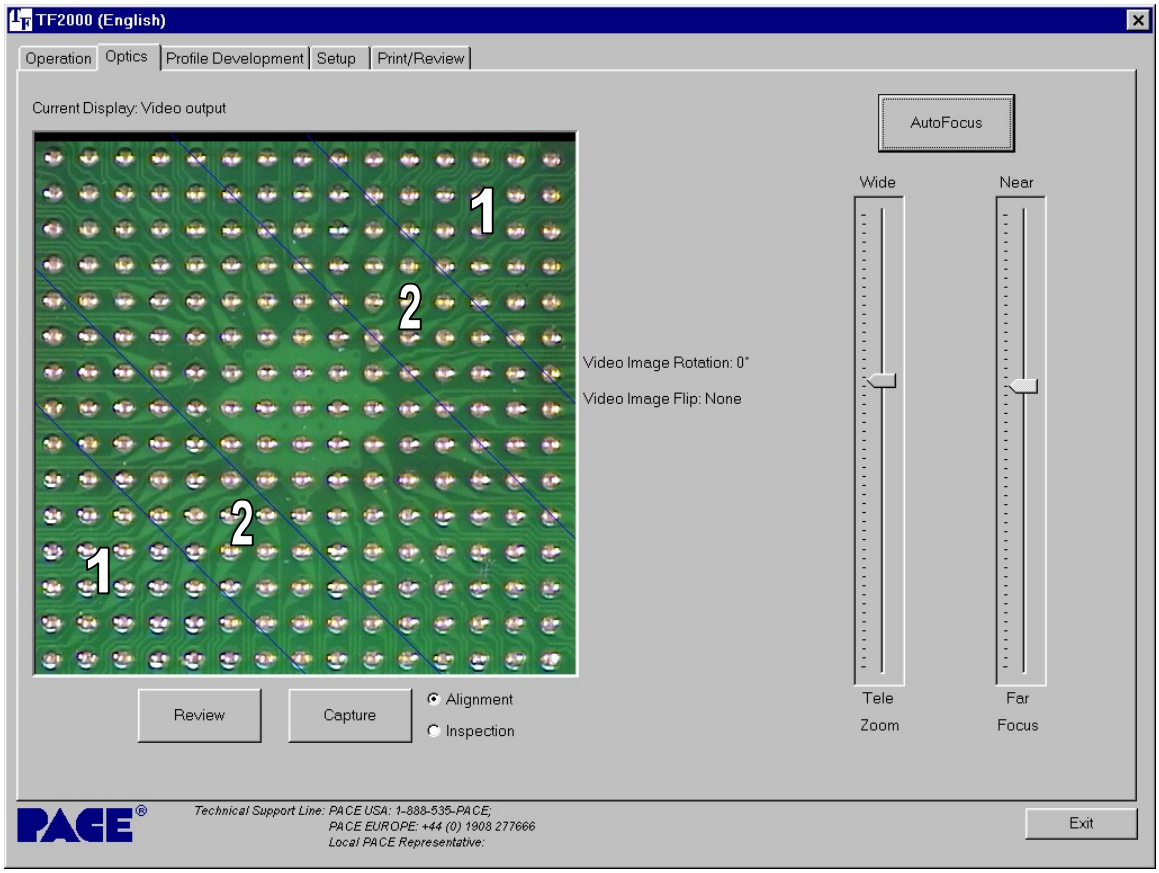
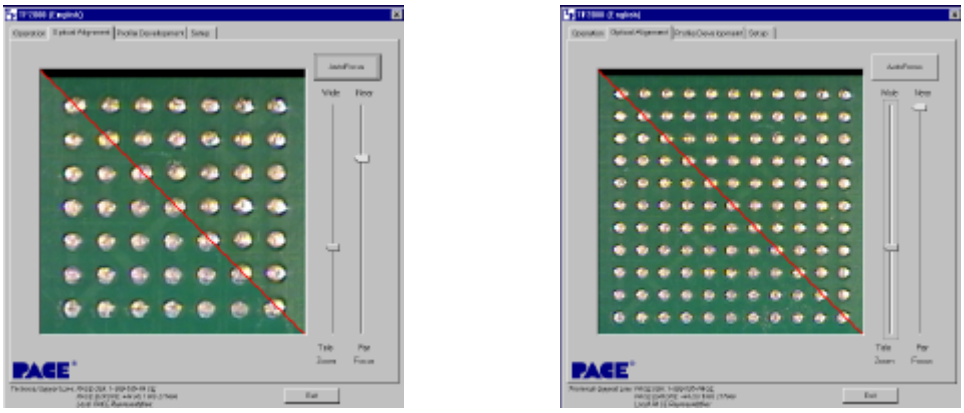



**Figure 14: Optics Tab Alignment View**

Zone 1: The lower left-hand corner and the upper right-hand corner up to the diagonal lines marked “1”.

Zone 2: The lower left-hand corner and the upper right-hand corner up to the diagonal lines marked “2”.

**Refer to Figure 15 for an example of Real Time Split Screen images.



(A) (B)

**Figure 15: Results from the Real Time Split Screen Feature Zone 1(A) and Zone 2(B)**

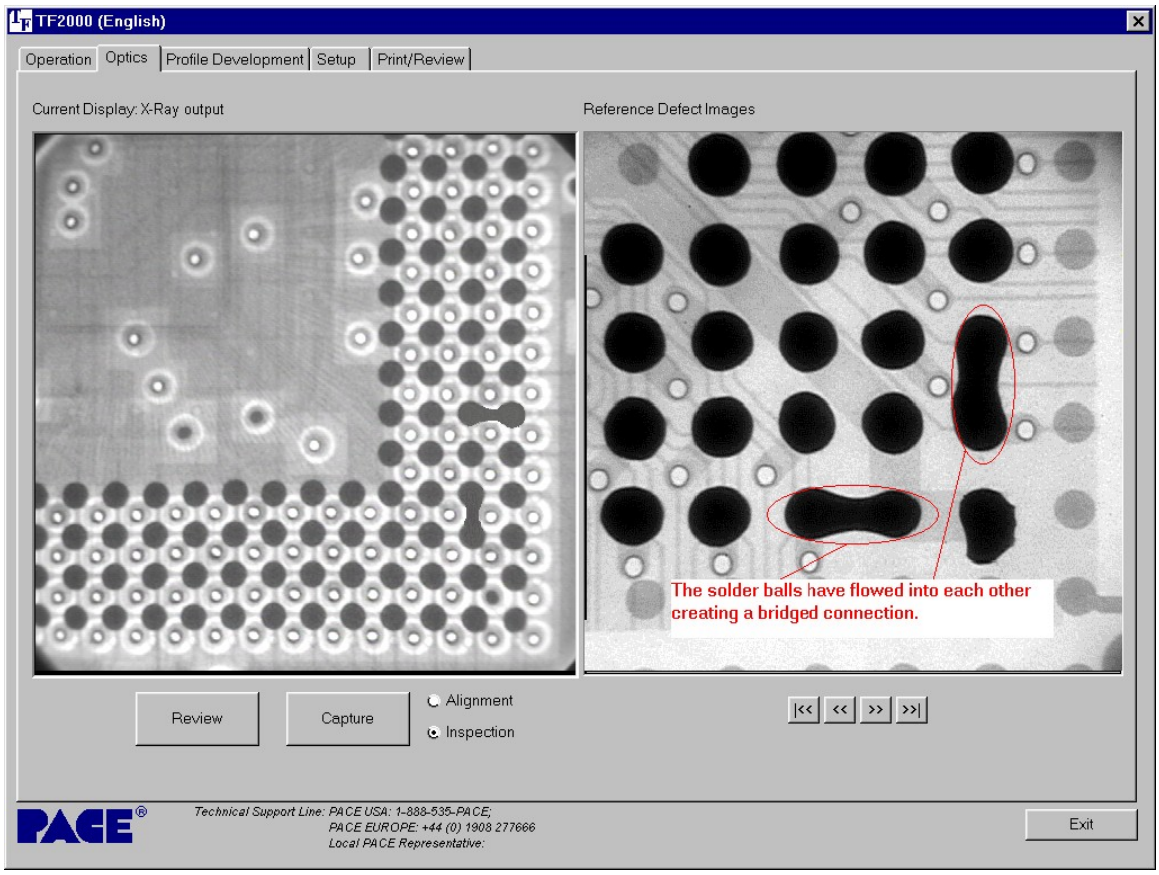
- To access Zone 1, click anywhere in Zone 1.
- To access Zone 2, click in between the diagonal lines marked “1” and “2”.
- Click anywhere on the Zone 1 or Zone 2 image to return to the original image.

1) Image Area - Shows overlay image of device and PCB for quick and easy alignment.
2) Real Time Split Screen feature – Provides 2 zones of split magnification. (Refer to Figure 14) The diagonal lines on the display indicate the zones.

3) AutoFocus/Manual Button – Allows the operator to toggle the camera focus control between manual and auto focus.
4) Zoom Slide Bar – Controls the amount of zoom from Wide to Telescopic viewing.
5) Focus Slide Bar – Allows focus to be adjusted
6) Review Button – Allows previously saved image to be recalled.
7) Capture Button – Saves current image to “Capture” folder or location of choice.
8) Video Selection – Image from TF 2000 is displayed.
9) Inspection Selection – Image from Inspection Device is displayed.

### 6-2.1 Optics Tab Inspection View

This Screen is used in conjunction with the XR 2000 X-Ray Inspection System. Real time X-Ray video can be viewed, stored and compared to a reference library of common faults or desired results.



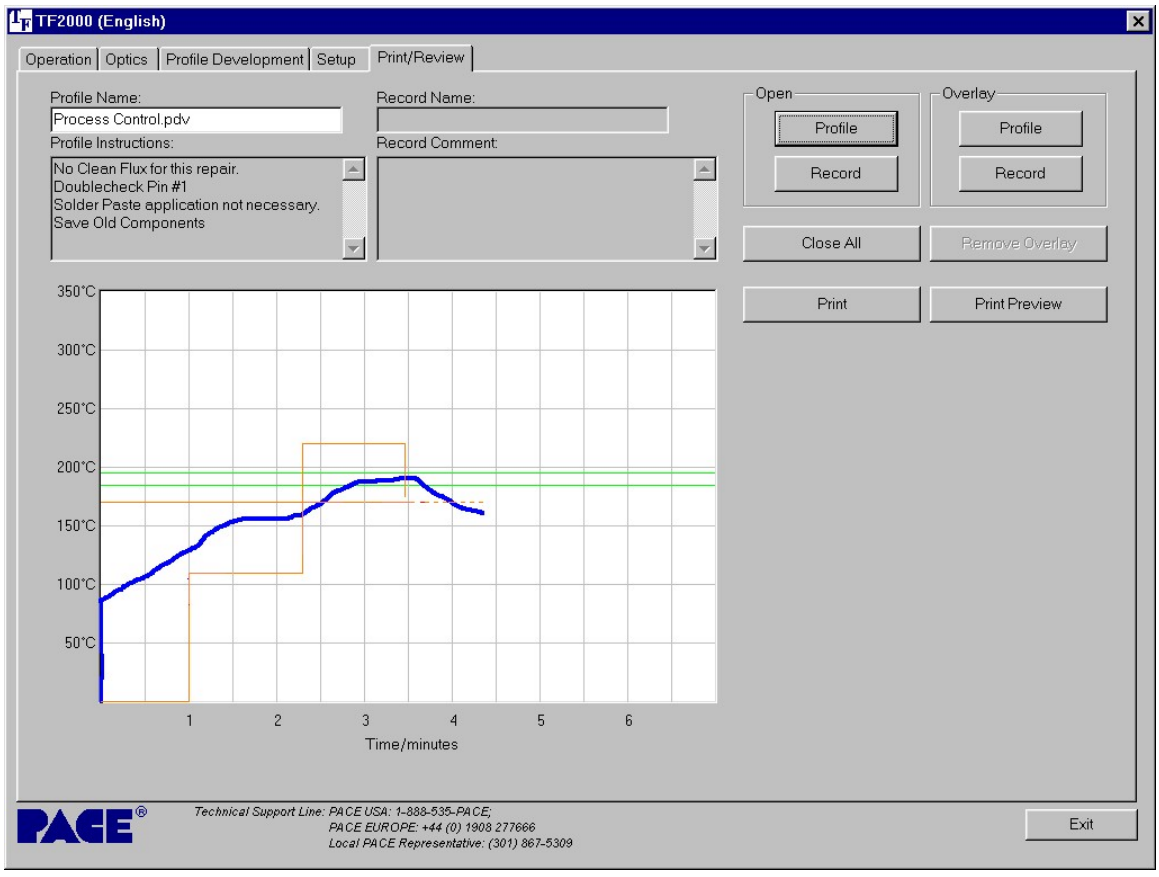

The Review and Capture Buttons operate the same as in Alignment View. The Arrow Buttons scroll between images stored in the reference library.

**To Add a Reference Image:** Any Image captured as a .bmp file may be converted to a .tif image using the “Imaging” program (located on the Windows Accessories Menu) and added to the “XrayLib” folder under the TF 2000 Software directory.

### 6-2.2 Print/Review Tab

This Screen allows the operator to recall and view saved profiles and operator records and output them to a specified printer.

1) Open Profile Button – Loads saved profile from disk and displays it on screen.
2) Open Record Button – Loads saved operator record and displays it in Record Comment.
3) Overlay Profile Button – Inserts a previously saved profile on screen to compare the currently viewed profile to.
4) Overlay Record Button – Inserts previously saved record on screen to compare currently viewed record to.
5) Close All Button – Clears all opened and overlaid Profiles and Records.
6) Print Preview Button – Opens Print Preview Screen
7) Print Button – Brings up Print Screen to select printer to output displayed record or profile.




**Print Review Tab**

## 6-3 Operation Tab

With the exception of the optical alignment, this screen allows the operator to perform all essential operations including profile selection, documenting operations for quality assurance, and process validation.

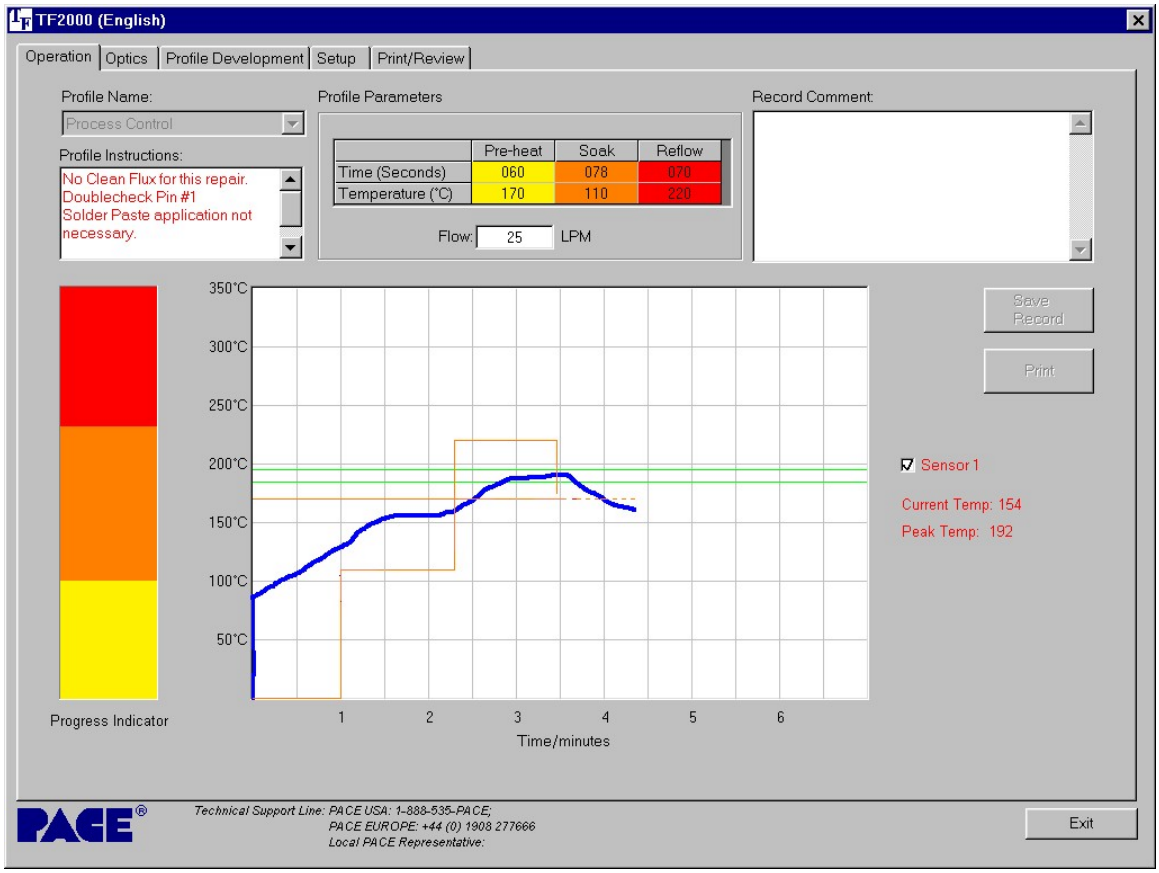

TF2000 (English)
Operation
Optics
Profile Development
Setup
Print/Review
Profile Name:
Process Control
Profile Instructions:
No Clean Flux for this repair.
Doublecheck Pin #1
Solder Paste application not necessary.
Profile Parameters
Pre-heat
Soak
Reflow
Time (Seconds)
060
078
070
Temperature (°C)
170
110
220
Flow:
25
LPM
Record Comment:
Save Record
Print
350°C
300°C
250°C
200°C
150°C
100°C
50°C
1
2
3
4
5
6
Time/minutes
Sensor 1
Current Temp: 154
Peak Temp: 192
Progress Indicator
PACE®
Technical Support Line: PACE USA: 1-888-535-PACE;
PACE EUROPE: +44 (0) 1908 277666
Local PACE Representative:
Exit

**Figure 16: Operation Tab**

1) Profile Name – Allows the operator to select the proper profile from a dropdown menu. When a profile is selected, the profile parameters are automatically downloaded to the TF 2000 working memory, profile #39.
2) Profile Instructions – Displays instructions pertinent to the selected profile.
3) Record Comment area – Provides a means for documenting essential information.
4) Save Record Button – Stores profile name, date & time, operator comments and graph information in "Records" folder.
5) Progress Indicator – Visual indication of the profile process.

   **NOTE:** A record is defined as information associated with a particular rework job. This information includes profile parameters (via the graph), sensor input, and operator recorded comments. A record can be saved for each new component installation. When a record is saved, the date, time and profile name are automatically stored with that record.

6) Graph area – Graphically displays profile parameters (time and temperature) and a sensor input. The box next to Sensor 1 in the right hand margin must be checked to activate this function.

### 6-3.1 Process Control/Validation Feature

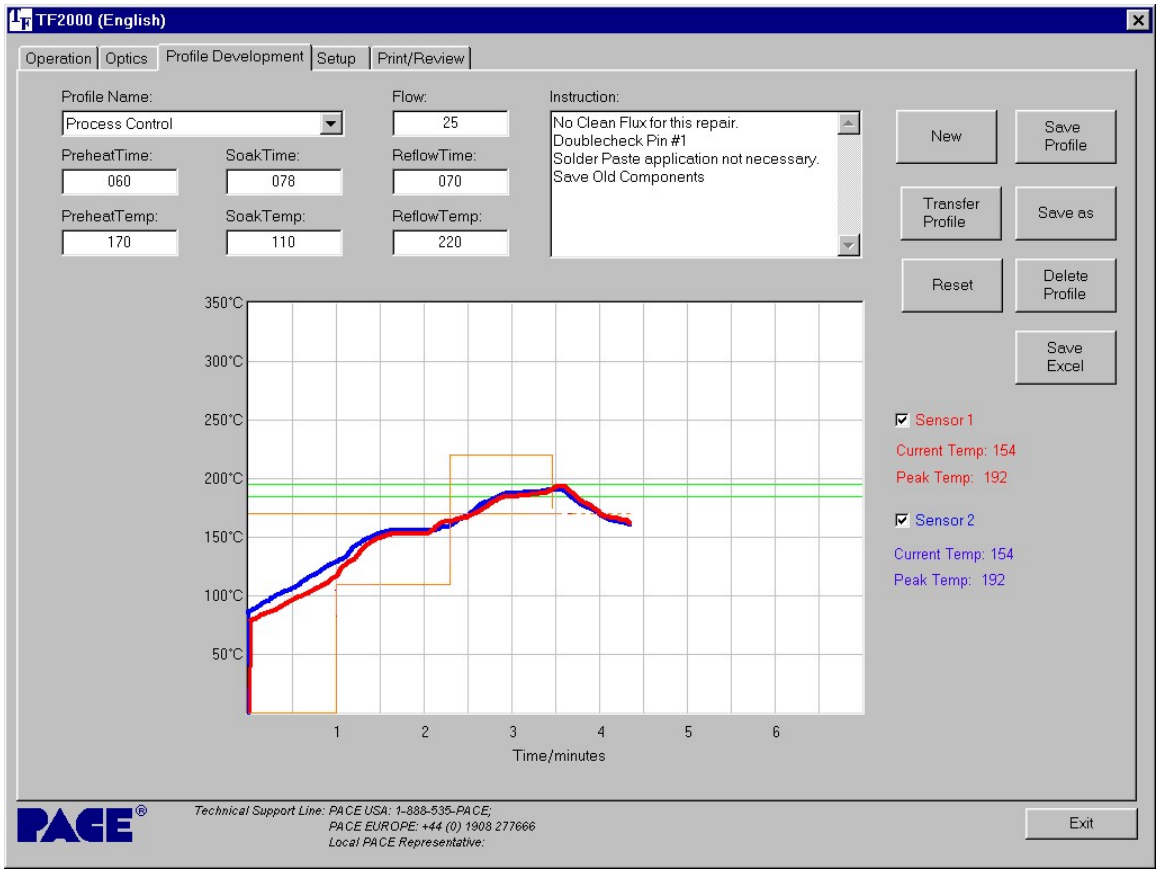



**Figure 17: Process Validation**

During the Profile Development phase, a temperature probe trace can be saved with an associated profile. A reference point near the component rework area (on an adjacent component lead for example) must be used for temperature probe placement. Location can be stored in “Profile Instructions”. Keep in mind that data must be collected from the same Temp probe place at the selected location when saving profile temperature and rate with the profile.

When an operator selects an appropriate profile, the temperature probe trace will be displayed on the graph in blue. To validate the rework process, the operator can place the temperature probe on the designated reference point, check the box next to Sensor 1 in the right hand margin and run the profile. As the profile progresses, the temperature probe trace will be displayed in red. The two probe traces can be compared to validate a particular rework process. (See Figure 17) Some variation may exist due to differences in Temp probes, positioning, and operator error. The “shape” of the curves should be similar.

## 6-4 Profile Development Tab

This screen is designed for the profile development engineers. Access to this screen can be password protected. Profiles can be created, modified, and/or deleted from this screen. Specific operator instructions applicable to a particular profile can also be entered from this screen.

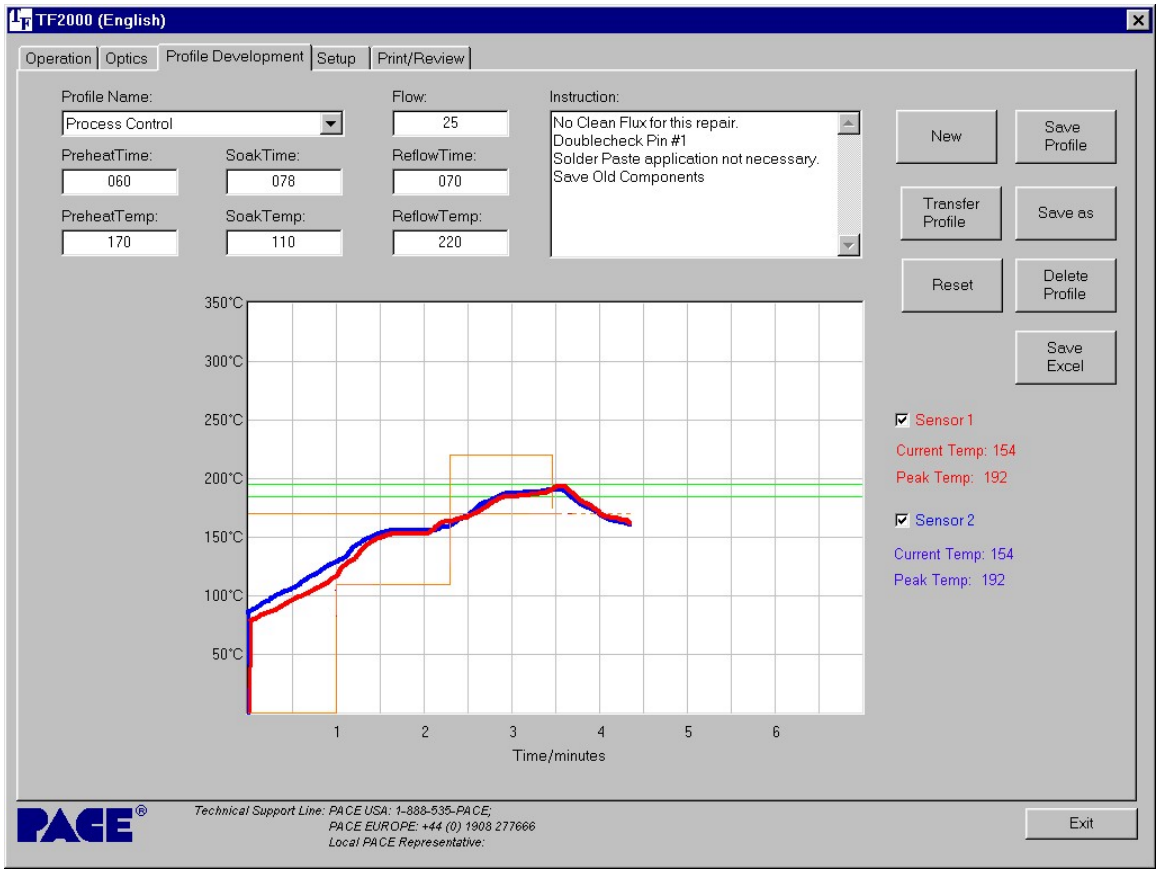

TF2000 (English)
Operation
Optics
Profile Development
Setup
Print/Review
Profile Name:
Process Control
Flow:
25
Instruction:
No Clean Flux for this repair.
Doublecheck Pin #1
Solder Paste application not necessary.
Save Old Components
PreheatTime:
060
SoakTime:
078
ReflowTime:
070
PreheatTemp:
170
SoakTemp:
110
ReflowTemp:
220
New
Save Profile
Transfer Profile
Save as
Reset
Delete Profile
Save Excel
350°C
300°C
250°C
200°C
150°C
100°C
50°C
1
2
3
4
5
6
Time/minutes
Sensor 1
Current Temp: 154
Peak Temp: 192
Sensor 2
Current Temp: 154
Peak Temp: 192
PACE®
Technical Support Line: PACE USA: 1-888-535-PACE;
PACE EUROPE: +44 (0) 1908 277666
Local PACE Representative:
Exit

**Figure 18: Profile Development Tab**

1) Profile Name and Parameters (upper left-hand corner) – Allows the operator to select a stored profile and displays time and temperature settings for each phase of the Reflow cycle.
2) Instruction Box – Provides a means to store and display operator instructions applicable to the selected profile. Instructions may pertain to
   such items as nozzle type, type of solder paste or flux, reference position of temperature probe for process validation, and any other special needs.
3) "New" Button – Clears Profile Name field and resets all profile parameter fields to 0. Allows the operator to enter the new time and temperature values for each phase of the Reflow cycle.
4) "Save Profile" Button – Saves profile parameters for the selected profile. Clicking this button will overwrite existing profile parameters for named profiles. A pop-up box will appear for new unnamed profiles.
5) "Transfer Profile" – Transfers the selected profile to the working memory in the TF 2000. The working memory is profile number 39 on the TF 2000. Profile parameters transferred to the working memory will automatically be displayed in the LCD window on the TF 2000.
6) "Save As" Button – Used for renaming profiles and naming new profiles. A pop-up box will appear when pressed.
7) "Reset" Button – Clears sensor input lines from the graph.
8) "Save Excel" Button – Saves profile in .csv format that can be opened in MS Excel.
9) "Delete Profile" Button – Deletes the selected profile from the PC. **Deleted** profiles cannot be retrieved.
10) Graph Area – Graphically displays profile parameters (time and temperature) and sensor inputs. Right Clicking the mouse on any area of this graph will display the temperature at the point selected. Left clicking the mouse on any two points will give the temperature slope rate between the two points.

### 6-4.1 General Information concerning the Profile Development Screen

1) The Reflow Graph area displays a representation of the Reflow cycle profile. Time in minutes is graphed along the X-axis and temperature in degrees Celsius is plotted along the Y-axis. The time and temperature axes incorporate a dynamic scaling feature to optimize the display for extremely short or long profiles. Profile graphs can be saved with profiles to be used for process validation by operators while using the Operation screen. Profile graphs can

also be stored as individual records for each rework job for quality control purposes. Solid and dotted lines are used to indicate profile parameters.

a) Horizontal Green Lines – Indicates upper and lower temperature limits as set on the Setup Tab.
b) Horizontal Dotted Line – Indicates the Bottom Heater set temperature. The dotted line becomes solid as the reflow cycle progresses.
c) 3-Tiered Dotted Line – Indicates Top Heater activity for each phase of the reflow cycle. The dotted line becomes solid as the reflow cycle progresses.
d) Red Line – Sensor 1 temperature over the period of the reflow cycle. Sensor 1 Box must be checked to allow for display of the sensor input.
e) Blue Line – Sensor 2 temperature over the period of the reflow cycle. Sensor 2 Box must be checked to allow for display of the sensor input.

Each Sensor input has a Temp and Peak field (right hand margin) associated with it. The Temp reading displays the current temperature reading and changes as the reflow cycle progresses. The Peak reading displays the highest temperature measured during the reflow cycle.

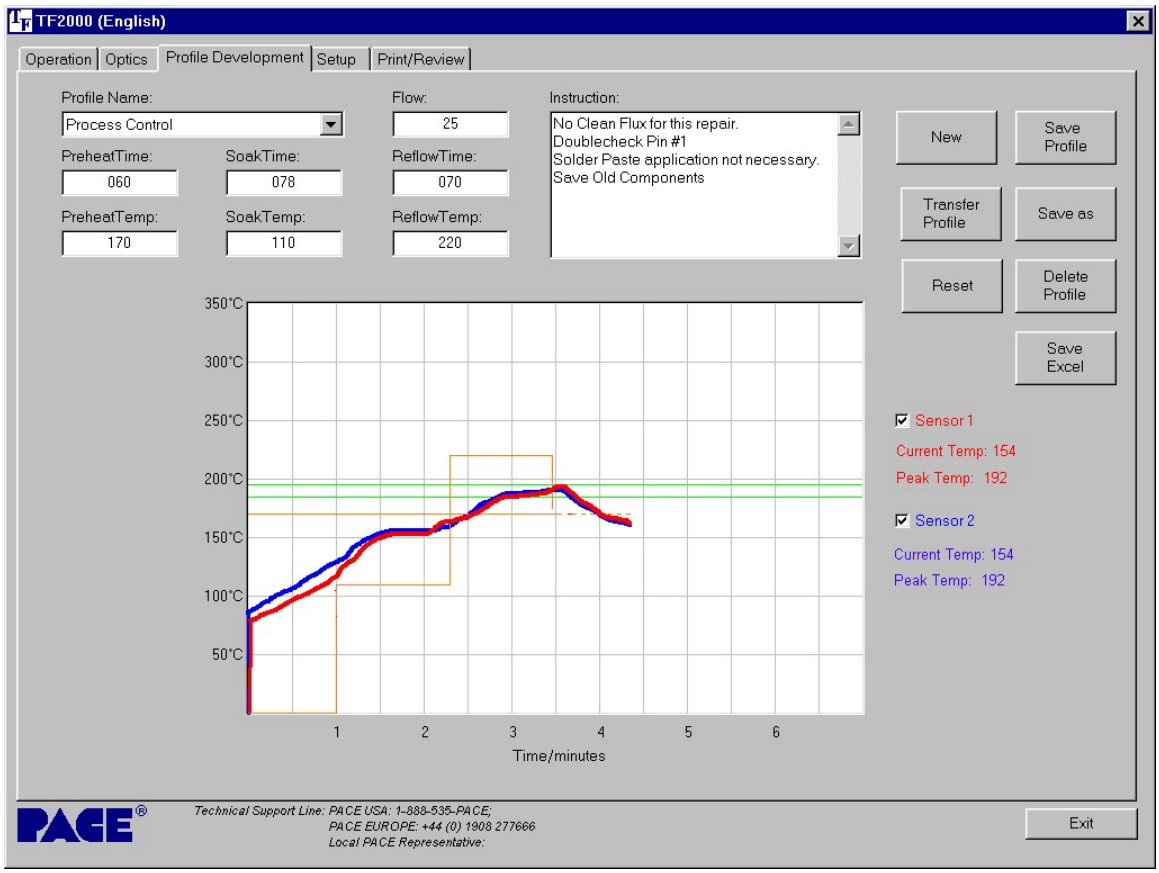



**Figure 19: Sample Profile Development Screen**

2) Profile parameters can be changed while the profile is running. Perform the following procedure to modify profile parameters while the profile is running:

   a) On the TF 2000, press the “Select” button until the cursor is at the parameter field to be changed.
   b) Press the “UP” or “DOWN” buttons to change the selected field. Numeric values change by increments of 2 for each press of the “UP” or “DOWN” button. See Figure 20.

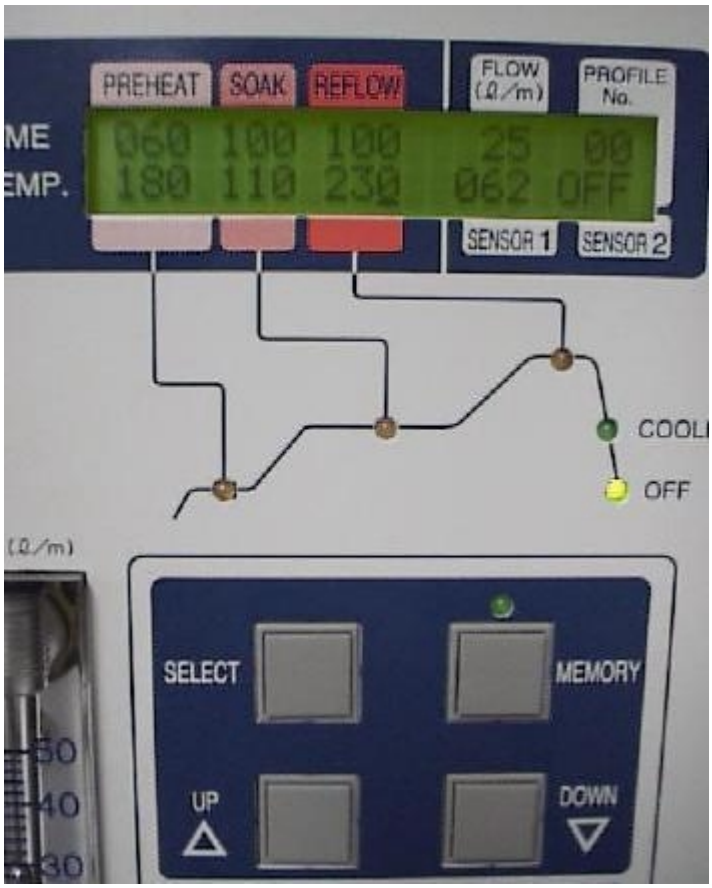



**Figure 20: LCD Display and UP and DOWN Buttons**

As the profile parameters are changed on the TF 2000, the profile parameter fields on the Profile Development screen will change to reflect the increase or decrease in time. The dotted lines on the graph will also change to reflect the new parameters. The Time fields on the software reflect "total" time after modification.

### 6-4.2 Profile Creation

There are 2 recommended methods for developing a profile. The first, involves an actual component installation, while the second uses a previously installed package. Either method can be used to develop a reliable profile. However, there are some issues and considerations to be aware of with each.

When developing profiles through actual component installation, it is critical to make sure the thermocouples remain in contact with the solder balls throughout the entire process. Unreliable data will be collected should a thermocouple lose contact with the solder balls. If

measuring the temperature on the top of the package it is best to use a preinstalled component.

When using a previously installed package, the placement of the thermocouples is important. They must be in contact with the existing solder joints. This task is best accomplished by drilling through the bottom of the PCB into a solder joint and attaching the thermocouple or by sliding the thermocouple under the package. When sliding a thermo couple under a component, it is critical that the thermo couple be in contact with a solder ball.

Information from the thermocouples will assist in determining the proper time and temperature parameters. In general, the following guidelines should be adhered to when developing profiles.

**Ramp and Maximum Temperatures**

Acceptable ramp rates and maximum temperatures should be obtained from the package manufacturer. It is recommended to select a maximum temperature below the manufacturer's specification to provide for a margin of safety. Typically, 20 °C below maximum is selected.

**Pre-Heat Phase**

1. In a "step profile", the top of the PCB and package should reach a stable temperature of 95-105 °C. If plotting the temperature curve, the trace should level off within this temperature range.

2. If a "linear slope" is desired, pre-heat and soak phases are combined. Both the package and the PCB are warmed at a constant ramp rate (usually 1-3 °C/second) until the desired soak temperature is reached.

**Soak Phase**

The soak phase is a crucial part of the reflow process. During this period, the flux activates and drives off volatiles and excess flux. A stable temperature of 145-170 °C (determined by the activation temperature of the flux used) should be maintained for approximately 40-60 seconds. This allows for uniform ramping across the entire package and PCB during reflow.

**Reflow Phase**

During this phase, the solder balls reach solder melt and form a joint between the package and the pads. It is critical for all areas of the array to reach solder melt together and all solder balls remain in a liquid state for at least 15-20 seconds.

Generally, the device should not be exposed to temperatures higher than 220 ºC. Always consult the device specifications for maximum temperature recommendations. As a rule of thumb, a safe "maximum temperature" is the maximum temp specified by the manufacturer minus 20ºC. Lower temperatures and shorter times are common in CSPs and FCs. **The lowest temperatures possible should always be used to ensure safety of the device and PCB.**

### Cool Down Phase

The cool down phase is necessary to bring the temperature of the package, solder joints and PCB under the package below solder melt temperatures. Cooling should be controlled. A good reference is to use the same cool down rate as for ramp up. The cooling fan on the TF 2000R will remain on for 55 seconds from the start of the cool down cycle. Some types of components (like CBGAs) should be allowed to cool without external assistance from the cooling fan.

## General

Using the baseline defaults in memory locations 00, 01 and 02 will provide a good starting point for profile development. The reflow graph provides an excellent tool for monitoring profile parameters and fine tuning or perfecting the profile development process.

When adjusting profile parameters "on-the-fly", all changes are reflected immediately on the profile development screen and graph.

# 7 MAINTENANCE

The TF 2000 is designed to operate with a minimum level of maintenance. However, replacement of some parts will be required from time to time. Please follow the maintenance instructions below when replacing parts. If there are any questions, contact PACE.

**CAUTION: Disconnect the main power supply and computer cables, if applicable, BEFORE opening the TF 2000B, TF 2000BE, TF 2000BL, TF 2000BLE, TF 2000R, TF 2000P, BEFORE replacing any component of the TF 2000, and BEFORE performing ANY routine maintenance.**

## 7-1 Cleaning the Blower Filter

**Clean the filter every three (3) months.**

1) Take off the cover on the back of the TF 2000R. Please see Figure 2.
2) Loosen the butterfly screw fitted inside.
3) Remove the filter from the housing.
4) Clean the inside filter using warm water.
5) Make sure the filter is dry before re-assembly.

## 7-2 Replacing the Top Heater

Please refer to Figure 21 for heater replacement.

1) Disconnect the TF 2000 from **ALL** power supplies.
2) Remove the protective cover from the reflow head by removing the four screws on the left side.
3) Loosen the two screws in the terminal block that affix the wires from the top fan.
4) Set the fan aside.
5) Loosen the two bolts on the top of the assembly.
6) Lift off the connectors that secure the wires from the power indicator lamp on the front of the protective cover.
7) Set the cover aside.
8) Lift off the heater wires from the mounting posts.
9) Remove the terminal block taking out the two screws that secure it to the assembly.
10) Pull off the rubber hose from the connection on the top of the assembly.
11) Loosen the three Philips head screws from the sides of the housing and the hex bolt in the back that secure the top cover of the assembly

12) Lift off the cover and pull out the heater.
13) Replace heater and reassemble assembly.

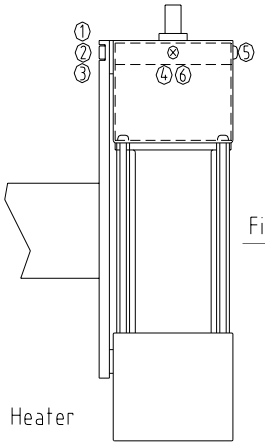



**Figure 21: Heater Assembly**

# 8 ALIGNMENT & CALIBRATION

All PACE TF 2000 BGA/CSP Rework Systems are factory aligned and calibrated prior to shipment. Due to adverse shipping and handling conditions, it may be necessary to perform one or more of the following alignment and calibration procedures prior to use. Proper alignment and calibration of system components should also be performed on a semi-annual basis to ensure peak performance.

## 8-1 Board to Optics Aalignment

This alignment should be performed when the land pattern on the PCB appears skewed on the video display.

**NOTE:** For TF 2000L/LE models, refer to the Alignment and Calibration Differences in Section 10.

1) Position testing PCB in Board Holder.
2) Pull the optics housing out from the front of the TF 2000P using the handle.
3) Zoom in so the lands on the PCB fill the screen.
4) Observe land pattern. If land pattern is skewed, proceed to step 5. See figure 22. If land pattern appears aligned, omit steps 5-7.
5) Loosen 8 setscrews found on both sides of the board holder.
6) Shift the board holder by hand until the image is no longer skewed.
7) Retighten setscrews, alternating from one side of the board holder to the other, until all 8 setscrews are tight.

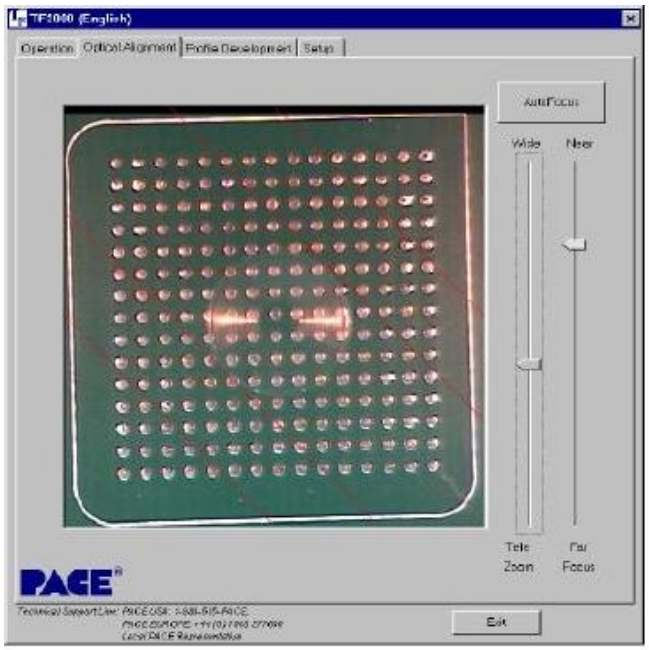



**Figure 22: Skewed Land pattern**

## 8-2 Sliding Shaft Holder Alignment (Indexing)

This alignment will correct X aspect errors when indexing the sliding shaft holder from the placement position to the reflow position and vice versa.

**NOTE:** For TF 2000L/LE models, refer to section 10 for the Sliding Shaft Holder Alignment.

**NOTE:** A reference point must be established for this procedure. The reflow position will serve as a reference point for this alignment calibration.

1) Position testing PCB in the board holder.
2) Set the sliding shaft holder at the reflow position flush against the left indexing tab.
3) Lower reflow heater nozzle to approximately 1/8" above a PCB component.
4) Visually center component in the "X" direction under nozzle using the adjustment knob on the sliding shaft holder.
5) Using the handle on the sliding shaft holder, index the table from the reflow position to the placement position.
6) Pull the optics housing out from the front of the TF 2000P using the handle.
7) Zoom in so the lands on the PCB fill the screen.
8) The land pattern should be centered on the display horizontally (X direction). If centered, omit steps 9-16. Otherwise, proceed to step 9.
9) Set the sliding shaft holder in between the reflow and placement position.
10) Remove rubber stopper from right indexing tab on the base assembly.
11) Loosen center set screw on top of right indexing tab. See Figure 23.
12) Depending on the direction and amount of offset in the X plane, tighten or loosen the large setscrew on the side of right indexing tab.

**Note:** Tightening the large setscrew will shift the displayed image to the right. Loosening the same setscrew will shift the image to the left.

13) Reinstall rubber bumper on large setscrew.
14) Return sliding shaft holder to the placement position.

15) Observe proper centering of land pattern on video display. If centered, proceed to step 16. Otherwise, repeat steps 9-14 until proper centering is achieved.
16) Tighten center set screw on top of right indexing tab.

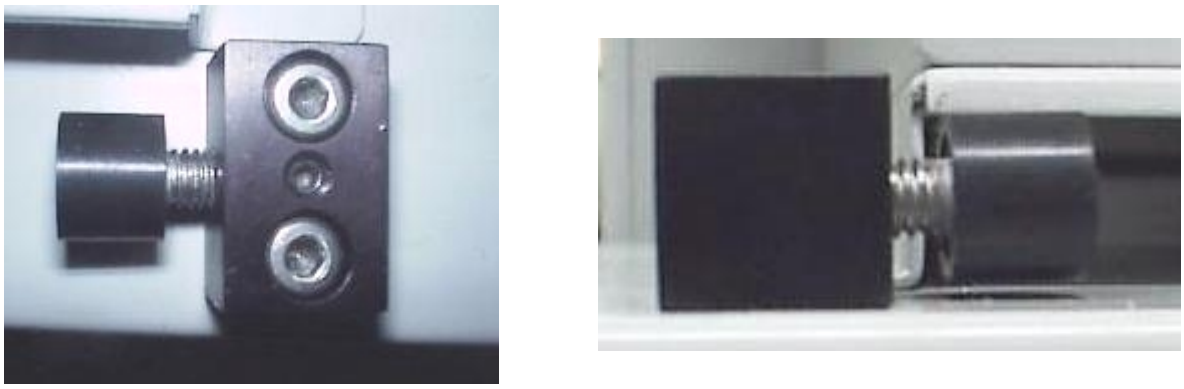


**Figure 23: Top and Side View of Indexing Tab**

## 8-3 Vacuum Nozzle Planarity

The Vacuum Pick nozzle must land flush on the PCB component in order to achieve parallelism and adequate suction. Performing the following procedure can rectify problems in vacuum nozzle planarity.

1) Remove the cover on the Alignment Apparatus by removing the three bolts on the top of the cover and the “Y” adjustment knob. The “Y” adjustment may have to be brought forward to allow the cover to clear the shaft.
2) Place a PCB on the board holder and install the large nozzle.
3) Lower the alignment apparatus to the PCB.

**NOTE:** To achieve parallelism in the “X” direction, perform steps 4-7. In order to achieve parallelism in the “Y” direction, perform steps 8-11.

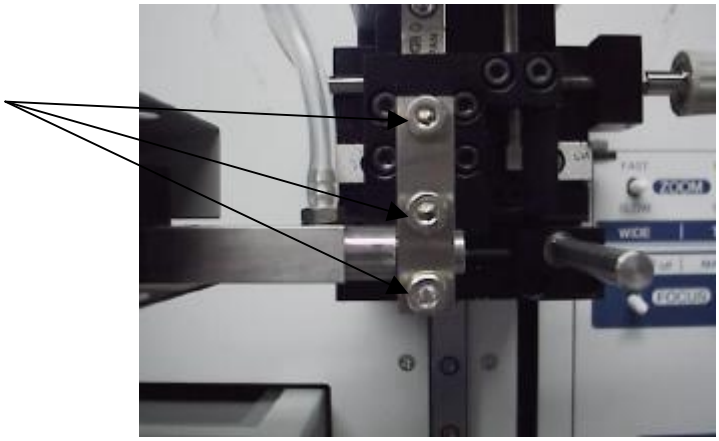


Figure 24: Three vertical setscrews on the alignment apparatus

### 8-3.1 X Correction Refer to Figure 24

1) Loosen the top 2 setscrews facing the front of the alignment apparatus.
2) Lightly press right over the vacuum pick to suck the PCB.
3) Turn the “Z” knob right or left to meet the parallel face of the vacuum pick nozzle and the PCB. When parallel, the vacuum noise will be low.
4) Retighten the 2 setscrews while maintaining light pressure over the vacuum pick assembly.

### 8-3.2 Y Correction **Refer to Figure 24**

1) Loosen the bottom setscrew facing the front of the alignment apparatus.
2) Lightly press right over the vacuum pick to suck the PCB.
3) Turn the “Z” knob right of left to meet the parallel face of the vacuum pick nozzle and the PCB. When parallel, the vacuum noise will be low.
4) Retighten the bottom setscrew while maintaining light pressure over the vacuum pick assembly.

## 8-4 Reflow Head Planarity Alignment

When lowered and properly aligned, the nozzle on the reflow head should land flush with the PCB. Errors in reflow head planarity (both X and Y aspects) can be corrected by performing the following alignment.

### 8-4.1 X Correction

1) Position the test PCB in the board holder and index the sliding shaft holder to the reflow position.
2) Lower reflow head and nozzle to just above the PCB.
3) Turn off the power to the Reflow unit.
4) Loosen 2 setscrews located on the backside of the reflow head, on both sides of the arm that extends out to the reflow head.

   **NOTE:** Allow ample time for cooling before handling the reflow head.

5) Adjust position of the reflow head by hand until parallelism is achieved in the “X” direction.
6) Retighten 2 setscrews on the back of the reflow head while holding reflow head in correct position.

### 8-4.2 Y Correction Refer to Figure 25.

1) Remove the screws on the front and back of the base assembly, which are used to secure the Reflow unit to the base unit.
2) Remove the reflow assembly from the base and place on a stable platform.
3) Remove 8 philips head screws securing the housing for the Reflow unit and slide the housing assembly off.
4) Loosen 4 setscrews on the reflow head arm, located directly behind the front panel.
5) Manually adjust the reflow head until parallelism is achieved in the “Y” direction.
6) Retighten 4 large setscrews maintaining position of reflow head.

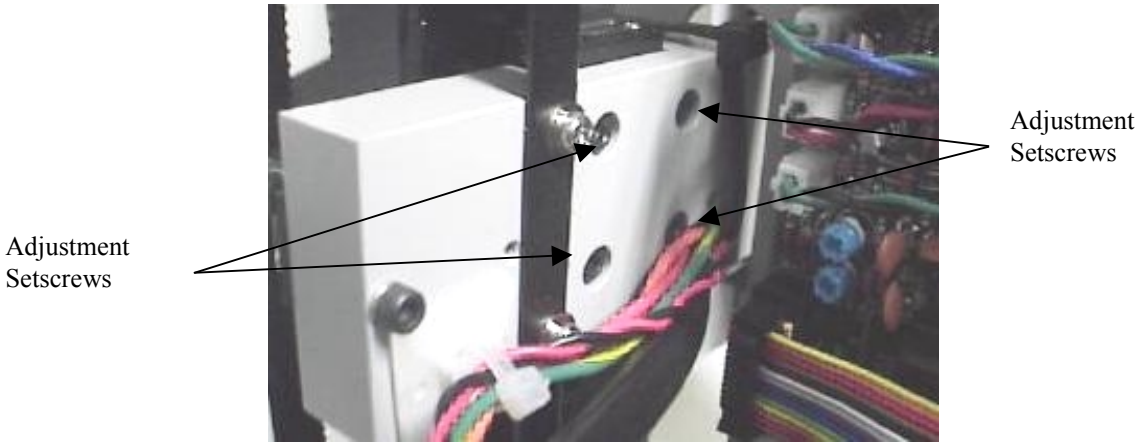



**Figure 25: Y Correction setscrews for Reflow Head Planarity Alignment**

## 8-5 Reflow Head – “Y” Directional Adjustment

This adjustment should be performed when the Reflow Head is either too far forward or too far back (“Y” aspect) when lowered down onto the PCB. If the nozzle does not land flush (planar) on the PCB, perform the Reflow Head Planarity alignment before this adjustment.

**NOTE:** Ensure the nozzle assembly is properly seated in the Reflow head. If the nozzle if improperly seated, the nozzle and Reflow head may appear to be too far forward when lowered down onto the PCB.

1) Remove the screws on the front and back of the base assembly, which are used to secure the Reflow unit to the base unit.
2) Remove the reflow assembly from the base and place on a stable platform.
3) Remove 8 philips head screws securing the housing for the Reflow unit and slide the housing assembly off.
4) Place the reflow assembly (uncovered) back on the base and secure with the screws on the front and back.

   The Reflow Head is attached to a vertical structure (block) that is secured to the bottom of the reflow unit by 2 allen head screws.

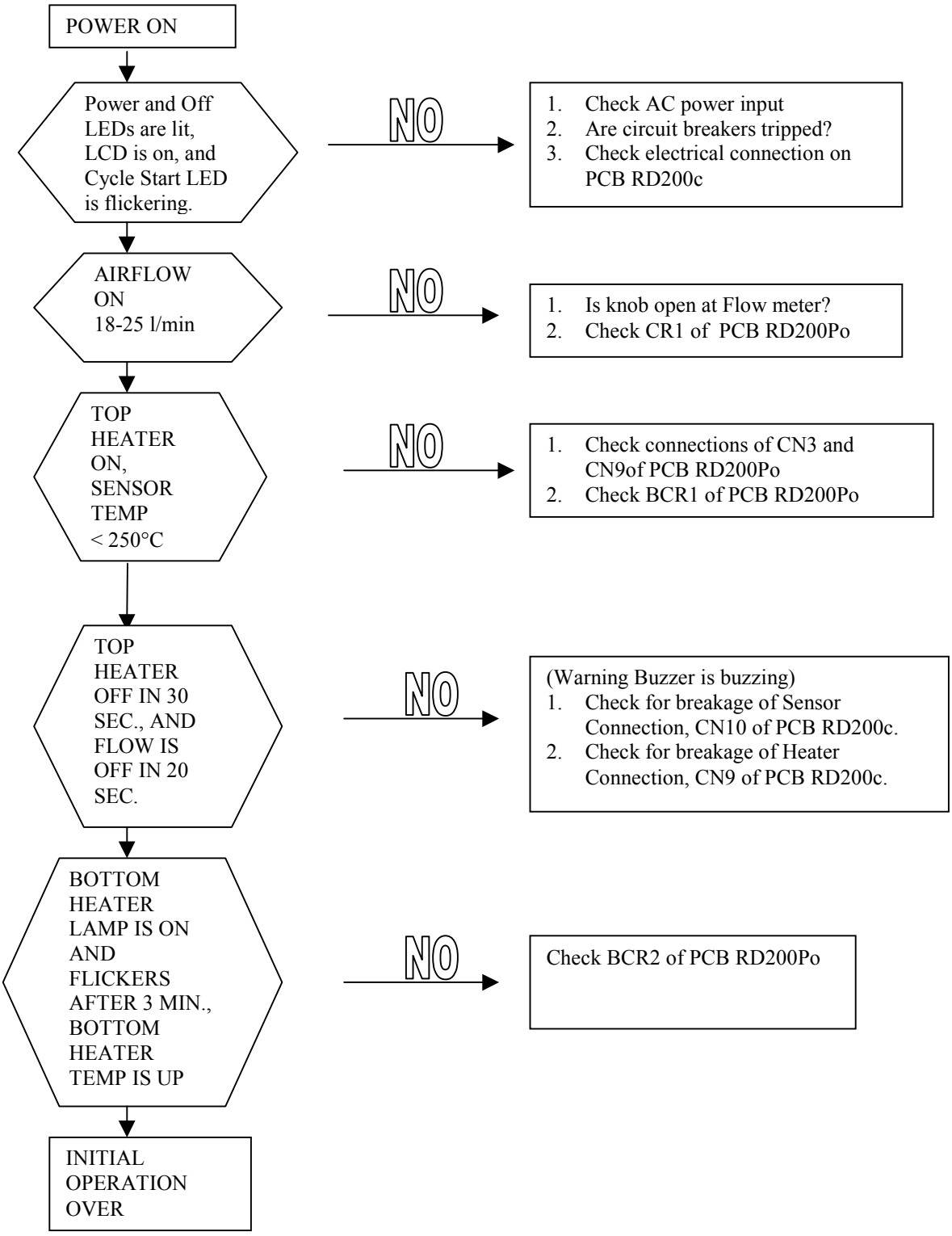
5) Locate the slot for the allen head screws on the underside of the base assembly directly under the reflow head.
6) Loosen the two allen head screws.
7) Slide the vertical structure either forward or back to compensate for the “Y” directional aspect error of the Reflow Head.
8) When the “Y” aspect error is corrected, retighten the 2 allen heads.
9) Re-install the cover on the reflow unit.

# 9 GENERAL TROUBLESHOOTING

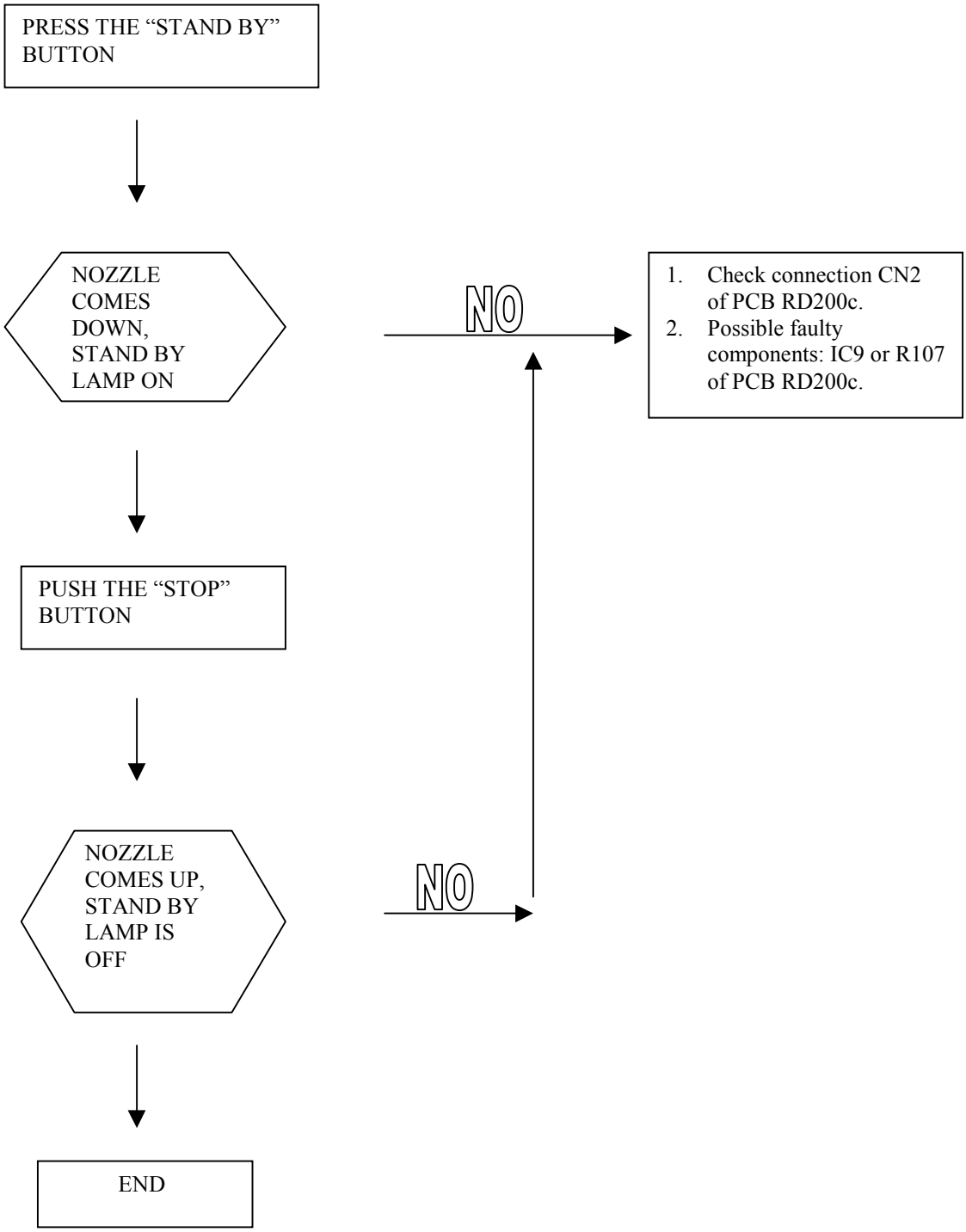
The following procedures are designed to allow the operator to perform basic visual inspections of system components. (ie. loose connections, equipment misalignment, etc.) If you ever have any questions, contact PACE.

**Initial Operation**

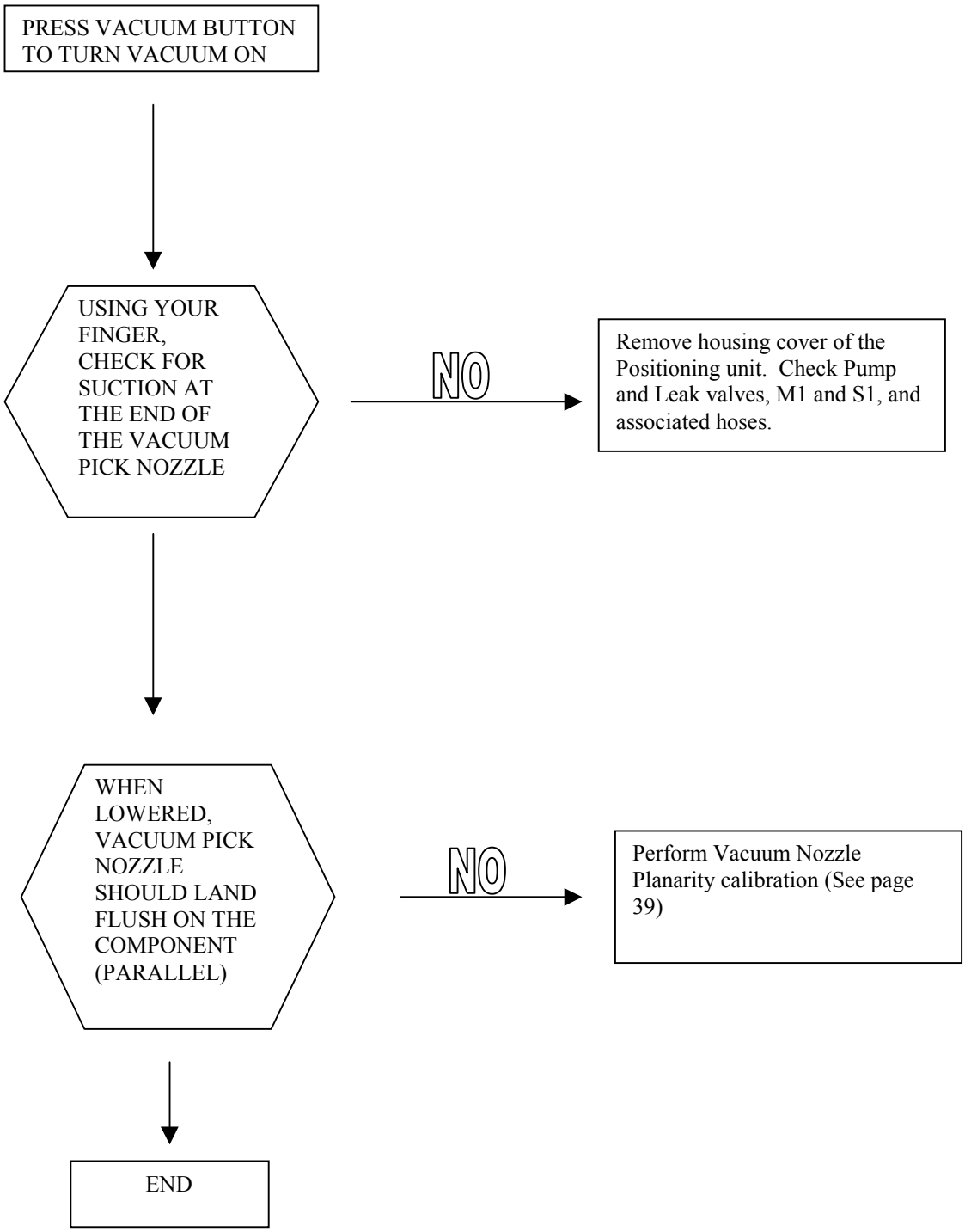
The Reflow unit will conduct an initialization sequence each time the power is turned on. The following flow diagram can be used to isolate failures during this initialization sequence.


POWER ON
Power and Off LEDs are lit, LCD is on, and Cycle Start LED is flickering.
NO
1. Check AC power input
2. Are circuit breakers tripped?
3. Check electrical connection on PCB RD200c
AIRFLOW ON 18-25 l/min
NO
1. Is knob open at Flow meter?
2. Check CR1 of PCB RD200Po
TOP HEATER ON, SENSOR TEMP < 250°C
NO
1. Check connections of CN3 and CN9of PCB RD200Po
2. Check BCR1 of PCB RD200Po
TOP HEATER OFF IN 30 SEC., AND FLOW IS OFF IN 20 SEC.
NO
(Warning Buzzer is buzzing)
1. Check for breakage of Sensor Connection, CN10 of PCB RD200c.
2. Check for breakage of Heater Connection, CN9 of PCB RD200c.
BOTTOM HEATER LAMP IS ON AND FLICKERS AFTER 3 MIN., BOTTOM HEATER TEMP IS UP
NO
Check BCR2 of PCB RD200Po
INITIAL OPERATION OVER

## Nozzle Up/Down Operation


PRESS THE "STAND BY" BUTTON
NOZZLE COMES DOWN, STAND BY LAMP ON
NO
1. Check connection CN2 of PCB RD200c.
2. Possible faulty components: IC9 or R107 of PCB RD200c.
PUSH THE "STOP" BUTTON
NOZZLE COMES UP, STAND BY LAMP IS OFF
NO
END

## Vacuum Nozzle Operation


PRESS VACUUM BUTTON TO TURN VACUUM ON
USING YOUR FINGER, CHECK FOR SUCTION AT THE END OF THE VACUUM PICK NOZZLE
NO
Remove housing cover of the Positioning unit. Check Pump and Leak valves, M1 and S1, and associated hoses.
WHEN LOWERED, VACUUM PICK NOZZLE SHOULD LAND FLUSH ON THE COMPONENT (PARALLEL)
NO
Perform Vacuum Nozzle Planarity calibration (See page 39)
END

## General Troubleshooting

| SYMPTOM | CORRECTIVE ACTION |
|---|---|
| Profile memory not storing profiles. | Check battery back up connection to CN5 of PCB RD200c. |
| Land pattern on PCB appears skewed or crooked on video display. | Perform Board to Optics Alignment. (See page 37) |
| Reflow head is not parallel with PCB | Perform Reflow Head Planarity Alignment. (See page 41) |
| Lamps in the optical housing assembly are not operational. | 1. Replace failed lamp or lamps.<br>2. Check transistors T1 (PCB side) and T2 (BGA side), or Micro-switch S1 located on the chassis. |
| The camera does not operate. | Check the wiring and connection of the camera. If nothing is found abnormal, replace the camera. |

# 10 TF 2000 L/LE MODEL DIFFERENCES

**Figure 26: TF 2000L/LE Model**

The TF 2000L/LE models are designed for rework and repair of larger PCBs. With the exception of the Bottom Side Heater, the Reflow and Placement stations are identical to the standard model. There are actually 2 Bottom Side heaters to provide bottom-side heating. The rails for the board supports are significantly longer than the standard model as well. These differences will be discussed in greater detail in the following paragraphs.

## 10-1 Installing the PCB Holder

1. Place the “Rail” between the two rows of bearings on the base of the TF 2000 L/LE.
2. Place sliding shaft holder onto slide with the knob facing out.
3. Install two screws on each side of the sliding shaft holder to secure board holder.
4. Install board supports by laying them across the front and back rails as indicated in Figure 27.

## 10-2 Bottom Side Heaters

The larger version of the TF 2000 houses 2 bottom-side heaters. The large bottom heater is movable in both the X and Y direction and is designed to heat the overall PCB. (See Figure 27) The TEMP knob on the bottom heater Switch Panel (See Figure 28) controls the temperature variation for the movable Bottom Side heater.

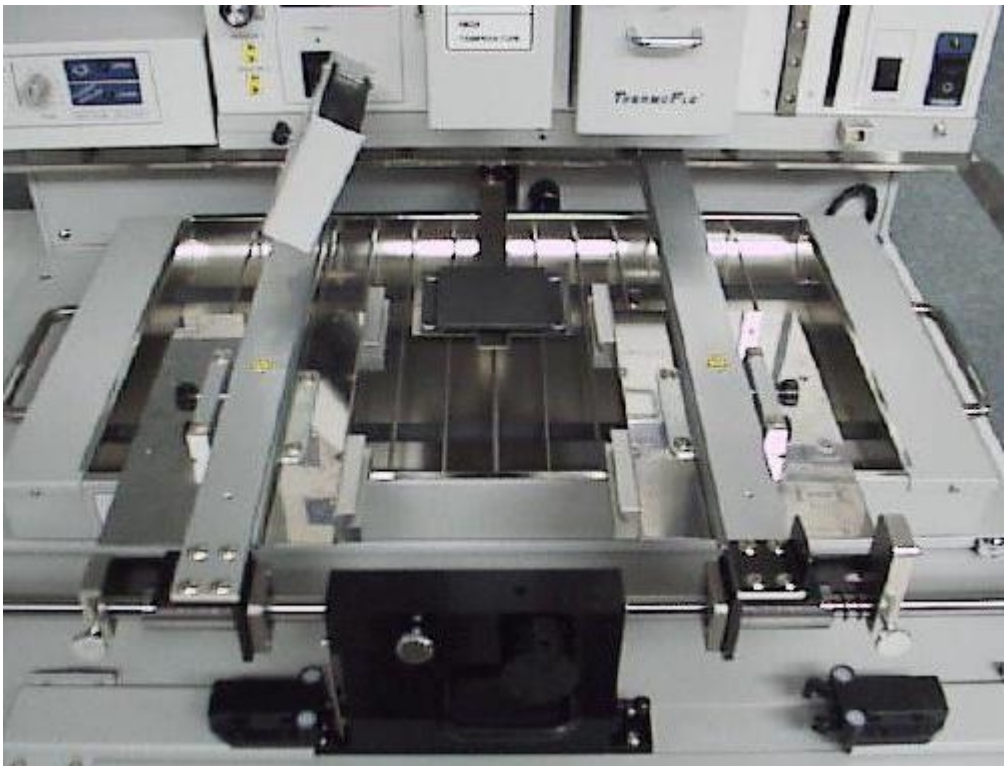


**Figure 27: Both Bottom-Side Heaters**

**Figure 28: Switch Panel for the Movable Bottom Heater**

**TEMP knob settings:**

TEMP knob set to 10 = 130 °C on the PCB
TEMP knob set to 8 = 80 °C on the PCB

**TEMP knob should be set at 8 or above during normal use

The small bottom-side pre-heater (located directly below the Reflow head) is non-movable and designed to provide intense heat directly under the BGA placement area. The temperature is controlled via the temperature profile.

## 10-3 Sliding Shaft Holder Indexing

In the standard model, the Sliding Shaft Holder slides freely from the placement position to the reflow position. For the TF 2000L/LE models, a locking mechanism must be released to index the Sliding Shaft Holder from one position to the other. A ball joint located on either side of the Sliding Shaft Holder seats into the locking mechanism. See Figure 29. To release the lock in the placement position, push the handle on the Sliding Shaft Holder to the right. The lock will release and spring tension inside the locking mechanism will push the Sliding Shaft Holder towards the Reflow position. When locked in the Reflow position, push the handle on the Sliding Shaft Holder to the left to release the lock.

**Figure 29: Ball Joint and Locking Mechanism**

## 10-4 Alignment and Calibration Differences

With the exception of the Board to Optics and Sliding Shaft Holder (Indexing) alignments, all alignments and calibrations are performed as previously described in Section 7.

The Board to Optics alignment is performed in essentially the same manner as the standard version. The only difference is on Step 5. Phillips head screws need to be loosened instead of Allen head setscrews.

The Sliding Shaft Holder Alignment (Indexing) for the TF 2000L/LE model is slightly different due to the locking mechanisms at the Reflow and Placement positions. Use the following procedure to perform this alignment.

> **NOTE:** A reference point must be established for this procedure. The reflow position will serve as a reference point for this alignment calibration.

1) Position the test PCB in the board holder.
2) Set the sliding shaft holder at the reflow position flush against the left indexing tab.
3) Lower reflow heater nozzle to approximately 1/8” above a PCB component.
4) Visually center component in the “X” direction under nozzle using the adjustment knob on the sliding shaft holder.
5) Using the handle on the sliding shaft holder, release the locking mechanism and index the table from the reflow position to the placement position. Be sure the lock latches.
6) Pull the optics housing out from the front of the TF 2000P using the handle.
7) Zoom in so the lands on the PCB fill the screen.
8) The land pattern should be centered on the display horizontally (X direction). If centered, omit steps 9-11. Otherwise, proceed to step 9.
9) Loosen the 4 Phillips head screws on the mounting bracket for the placement position locking mechanism. (See Figure 30)
10) Shift the mounting bracket to the right or the left until the image appears centered on the display.
11) Re-tighten Phillips head screws.

**Figure 30: Locking Mechanism Mounting Bracket (Top View)**

## 11 SPECIFICATIONS

1. Heater (top-side): Convective style, 1200 W heater
   Operating Temperature Range: 100ºC – 500º□C
2. Pre-heater (bottom-side): Light IR 400 Watt (200 W x 2)
   Operating Temperature Range: 100º□C – 260º□C
   Standard Pre-heater Size: 220mm x 155mm (8.6" x 6.1")
   Large version Pre-heater Size: 340mm x 470mm (13.3" x 18.5")
3. Heating control: K type thermo-couple with closed-loop control
4. Applicable Devices: BGA, CSP, LGA, BCC and etc. Max. 50 mm x 50 mm
5. Maximum PCB Size: Standard 360 mm (14") x 430 mm (17")
   With Optional Long Rails or L version: 500 mm (19.5) x 430 mm (17")
6. Airflow MAX: 25 l/min.
7. Component Adjustment Range of X,Y & Z: ±10 mm (±.4")
   □□□□□□□□□θ: Infinite Rotation
8. Adjusting volume of X, Y & Z: 0.5 mm (0.02") per revolution.
9. Positioning accuracy: 25 µm (0.001")
10. Maximum Vacuum: 450 mm Hg
11. Video Output: NTSC/BNC to Video Monitor, NTSC/S-Video for PC.
12. Power Source: 100V-120 VAC, 60 Hz, 230 VAC, 50 Hz
13. Power consumption (MAX):

    TF 2000 & TF 2000E: 1.6 KW
    TF 2000L & TF 2000LE: 2.1 KW

14. Dimensions:

    TF 2000 and TF 2000E
    516 mm (20.3") W x 491 mm (19.4") H x 517 mm (20.3") L

    TF 2000L and TF 2000LE
    710 mm (28") W x 491 mm (19.4") H x 680 mm (26.8") L

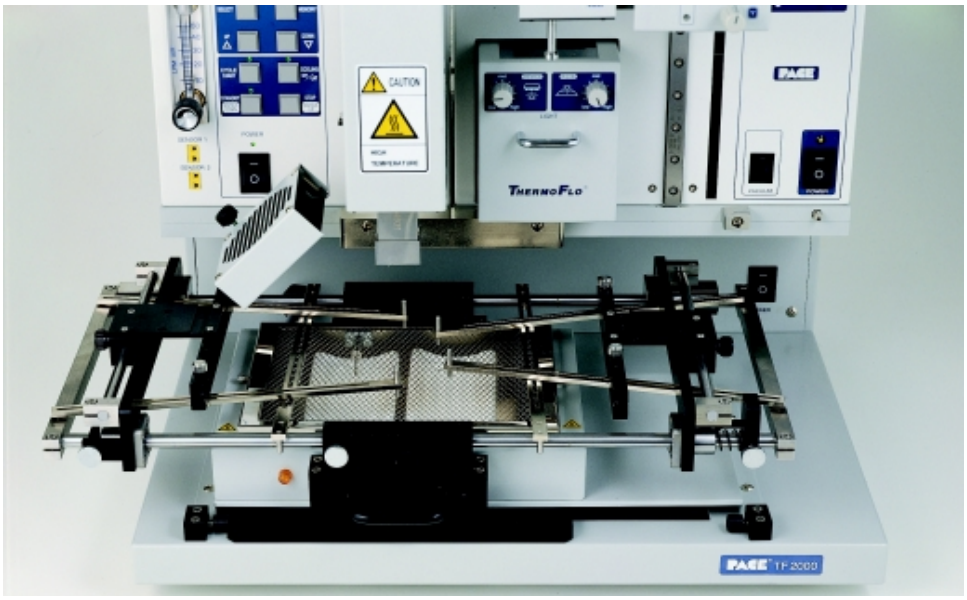
15. Weight:

| | |
|---|---|
| TF 2000, 115 VAC: | 57 kg (125.5 pounds) |
| TF 2000E, 230 VAC | 66 kg (145 pounds) |
| TF 2000L, 115 VAC | 75 kg (165 pounds) |
| TF 2000LE, 230 VAC | 84 kg (185 pounds) |

## Instructions for using the Board Supports

When performing rework on larger PCBs, the use of board supports may be required to keep the PCB level at all times. PACE supplies a set of board supports as optional equipment with the TF 2000. The set consists of 6 cast iron support bars. The two longest bars are positioned across the slide shafts on either side of the sliding shaft holder. The remaining four attach quickly to both sides of the board holder and rest on the bars positioned across the slide shafts providing a level surface for PCB placement. The following procedure details the proper usage for the board supports. (See Figure 26)

1) Install retaining screws at both ends of the bars to be positioned across the slide shafts. (2 longest bars)
2) Place supports across the slide shafts, one on each side of the sliding shaft holder.
3) Install an appropriate board support screw on the end of one of the remaining board supports.
4) Place a thumbscrew in one of the four holes on one side of the board holder.
5) Place a slide clip on the bottom of the board support and position under the board holder, directly beneath the thumbscrew.
6) Tighten thumbscrew just enough to hold the board support in place.
7) Position the board support in the desired location and tighten the thumbscrew for the associated board support. Repeat steps 3-7 for the remaining board supports.



## 12 ACCESSORY ITEMS

***Custom Nozzles can be ordered by contacting PACE.***

| | |
|---|---|
| Extended Rail for PCB | 4018-0098-P1 |
| Board Supports | 4018-0099-P1 |
| Optical Alignment Kit | 4018-0100-P1 |
| Nozzle, 5mm SQ | 4038-7001 |
| Nozzle, 6mm x 8mm | 4038-7002 |
| Nozzle, 8.2MM x 12.7mm | 4038-7003 |
| Nozzle, 9mm SQ | 4038-7004 |
| Nozzle, 10mm SQ | 4038-7005 |
| Nozzle, 13mm SQ | 4038-7006 |
| Nozzle, 15mm SQ | 4038-7007 |
| Nozzle, 17mm SQ | 4038-7008 |
| Nozzle, 23mm SQ | 4038-7009 |
| Nozzle, 27mm SQ | 4038-7010 |
| Nozzle, 35mm SQ | 4038-7011 |
| Nozzle, 44.5mm SQ | 4038-7012 |
| Nozzle, LQFP, 22mm SQ | 4038-7013 |
| Nozzle, LQFP, 16mm SQ | 4038-7014 |
| Nozzle, LQFP, 30mm SQ | 4038-7015 |
| Nozzle, LQFP, 9mm SQ | 4038-7016 |
| Nozzle, LQFP, 12mm SQ | 4038-7017 |
| Nozzle, LQFP, 26mm SQ | 4038-7018 |
| Nozzle, LQFP, 16mm x 22mm | 4038-7019 |
| Nozzle, LQFP, 14mm SQ | 4038-7020 |
| Nozzle, 14mm x 22mm | 4038-7021 |
| Nozzle, 50mm SQ | 4038-7022 |
| Nozzle, 60mm sq. | 4038-7023 |
| Nozzle, 40mm sq. | 4038-7024 |
| Nozzle, 25mm sq. | 4038-7025 |
| Nozzle 19mm sq. | 4038-7026 |
| Nozzle, 16.5mm x 8mm | 4038-7027 |
| Nozzle, 33mm sq. | 4038-7028 |
| Nozzle, 21mm x 25mm | 4038-7029 |
| Nozzle, 29mm sq. | 4038-7030 |
| Nozzle, 31mm sq. | 4038-7031 |
| Nozzle, 42mm sq. | 4038-7032 |
| Nozzle, Conn, 16mm x 13mm | 4038-7033 |
| Nozzle, Conn, 27mm x 13mm | 4038-7034 |
| Nozzle, Conn, 30mm x 12mm | 4038-7035 |

| | |
|---|---|
| Nozzle, Conn, 19mm x 8mm | 4038-7036 |
| Nozzle, 56mm x 17mm | 4038-7037 |
| Nozzle, w/ Baffle 28mm x 16 | 4038-7038 |
| Nozzle, 13mm x 10mm | 4038-7039 |
| Nozzle, 7.3mm x 7mm | 4038-7040 |
| Nozzle, 8mm SQ | 4038-7041 |
| Nozzle, 6mm SQ | 4038-7042 |
| Nozzle, 44mm SQ | 4038-7043 |
| Nozzle, 30mm SQ | 4038-7044 |
| Nozzle, 43mm SQ | 4038-7045 |
| Nozzle, 46mm SQ | 4038-7046 |
| Nozzle, 41mm SQ | 4038-7047 |
| Nozzle, 28mm SQ | 4038-7048 |
| Nozzle, 48mm SQ | 4038-7049 |
| Nozzle, 11.42mm X 5.08mm | 4038-7050 |
| Nozzle, 23mm X 32.5mm | 4038-7051 |
| Nozzle, 11mm X 17mm | 4038-7052 |
| Nozzle, 17mm X 32mm | 4038-7053 |
| Component Stenciling Tool Kit, 35mm-4 layer substrate | 7016-0006 |
| Component Stenciling Tool Kit, 27mm-4 layer substrate | 7016-0007 |
| Component Stenciling Tool Kit, 23mm 2 layer substrate | 7016-0008 |
| Component Stenciling Tool Kit, 23mm 4 layer substrate | 7016-0013 |
| Component Stenciling Tool Kit, 17mm 2 layer substrate | 7016-0009 |
| Component Stenciling Tool Kit, 17mm 4 layer substrate | 7016-0012 |
| Component Stenciling Tool Kit, 15mm-2 layer substrate | 7016-0010 |
| Component Stenciling Tool Kit, 15mm x 1 layer substrate | 7016-0023 |
| Component Stenciling Tool Kit, 13mm-2 layer substrate | 7016-0011 |
| Component Stenciling Tool Kit, 12mm CSP | 7016-0014 |
| Component Stenciling Tool Kit, 11x8 CSP | 7016-0015 |
| Component Stenciling Tool Kit, 40mm sq. | 7016-0016 |
| Component Stenciling Tool Kit, 25mm x 2 layer substrate | 7016-0017 |
| Component Stenciling Tool Kit, 25mm x 4 layer substrate | 7016-0020 |
| Component Stenciling Tool Kit, 19mm sq. | 7016-0018 |
| Component Stenciling Tool Kit, 16.5mm x 8mm, CSP | 7016-0019 |
| Component Stenciling Tool Kit, 33mm x 4 layer substrate | 7016-0021 |
| Component Stenciling Tool Kit, 22mm x 14mm | 7016-0022 |
| Component Stenciling Tool Kit, 4mm LCC | 7016-0024 |
| Component Stenciling Tool Kit, 31mm x 2 layer substrate | 7016-0028 |
| Component Stenciling Tool Kit, 31mm x 4 layer substrate | 7016-0032 |
| Component Stenciling Tool Kit, 8mm x 10mm | 7016-0031 |
| Component Stenciling Tool Kit, PLCC 28 | 7016-0033 |
| Component Stenciling Tool Kit, 9mm x 2 layer substrate | 7016-0034 |
| Component Stenciling Tool Kit, 24mm x 4 layer substrate | 7016-0035 |

| | |
|---|---|
| Component Stenciling Tool Kit, 6mm x 2 layer substrate | 7016-0036 |
| Component Stenciling Tool Kit, 7mm x 2 layer substrate | 7016-0038 |
| Component Stenciling Tool Kit, 11.42mm X 5.08 | 7016-0039 |
| Stencil, 35mm sq. 313 I/O | 1035-0313-P1 |
| Stencil, 35mm sq. 352 I/O | 1035-0352-P1 |
| Stencil, 27mm sq. 225 I/O | 1027-0225-P1 |
| Stencil, 27mm sq. 256 I/O | 1027-0256-P1 |
| Stencil, 27mm sq. 272 I/O | 1027-0272-P1 |
| Stencil, 27mm sq. 292 I/O | 1027-0292-P1 |
| Stencil, 27mm sq. 324 I/O | 1027-0324-P1 |
| Stencil, 27mm sq. 328 I/O | 1027-0328-P1 |
| Stencil, 23mm sq. 169 I/O | 1023-0169-P1 |
| Stencil, 23mm sq. 288 I/O | 1023-0288-P1 |
| Stencil, 23mm sq. 324 I/O | 1023-0324-P1 |
| Stencil, 23mm sq. 208 I/O | 1023-0208-P1 |
| Stencil, 23mm sq. 256 I/O | 1023-0256-P1 |
| Stencil, 17mm sq. 208 I/O | 1017-0208-P1 |
| Stencil, 17mm sq. 256 I/O | 1017-0256-P1 |
| Stencil, 15mm sq. 156 I/O | 1015-0156-P1 |
| Stencil, 15mm sq. 160 I/O | 1015-0160-P1 |
| Stencil, 15mm sq. 196 I/O | 1015-0196-P1 |
| Stencil, 15mm sq. 196 I/O | 1015-0196-P1 |
| Stencil, 13mm sq. 144 I/O | 1013-0144-P1 |
| Stencil, 12mm sq. 144 I/O | 1012-0144-P1 |
| Stencil, 12mm sq. 160 I/O | 1012-0160-P1 |
| Stencil, 11mm X 8mm 72 I/O | 1011-0072-P1 |
| Stencil, 40mm sq. 503 I/O | 1040-503-P1 |
| Stencil, 25mm sq. 357 I/O | 1025-0357-P1 |
| Stencil, 25mm sq. 360 I/O | 1025-0360-P1 |
| Stencil, 19m sq. 225 I/O | 1023-0256-P1 |
| Stencil, 16.5mm x 8mm 52 I/O | 1016-0052-P1 |
| Stencil, 33mm sq. 503 I/O | 1033-0503-P1 |
| Stencil, 14mm x 22mm 119 I/O | 1014-0119-P1 |
| Stencil, 4mm sq. 24 I/O | 1004-0024-P1 |
| Stencil, 4mm sq. 28 I/O | 1004-0028-P1 |
| Stencil, 31mm x 304 I/O | 1031-0304-P1 |
| Stencil, 31mm x 329 I/O | 1031-0329-P1 |
| Stencil, 31mm x 316 I/O | 1031-0316-P1 |
| Stencil, 8mm x 48 I/O | 1008-0048-P1 |
| Stencil, PLCC 28 I/O | 1012-0028-P1 |
| Stencil, 9mm x 56 I/O | 1009-0056-P1 |
| Stencil, 24mm x 241 I/O | 1024-0241-P1 |
| Stencil, 6mm x 40 I/O | 1006-0040-P1 |

| | |
|---|---|
| Stencil, 7mm x 48 I/O | 1007-0048-P1 |
| Stencil, 11.4 x 5.1 x 22 I/O | 1011-0022-P1 |
| Flux Applicator Tool Kit | 6993-0218 |
| K-Type Thermo Couple (2) | 1340-0174-P5 |
| Air Pump | 6008-0147-P1 |
| Gear Motor | 6008-0146-P1 |
| Halogen Lamp - 2 pack | 6007-0018-P1 |
| Heater Element for Bottom Heater | 6010-0104-P1 |
| Heater Element for Top Heater | 6010-0103-P1 |
| Large Power Supply Unit | 6008-0150-P1 |
| Light Control PCB | 6020-0135-P1 |
| PCB Main | 6020-0133-P1 |
| Power Control PCB | 6020-0134-P1 |
| Small Power Supply Unit | 6008-0149-P1 |
| Suction Cup, 5 each | 6993-0202-P1 |
| Vacuum Pump | 6008-0148-P1 |
| Vacuum Nozzles for TF2000 Pack 3 | 6993-0203 |
| Fuse 3 A TF 2000 | 1159-0269-P1 |
| Hand Held Vacuum Pick, TF2000 | 1272-0005-P1 |